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WAR DEPARTMENT

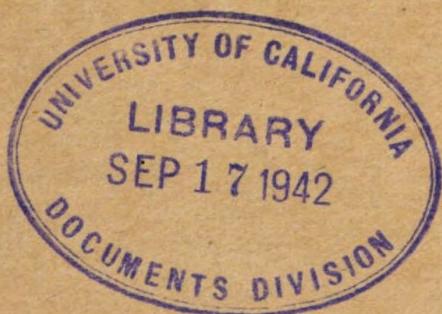
U.S. Army

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

**TELESCOPE MOUNTS M21 AND M23;
PANORAMIC TELESCOPES
M5A3 AND M12A2;
RANGE QUADRANT M4;
ELBOW TELESCOPE M16; AND
INSTRUMENT LIGHT M5**

May 4, 1942



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TM 9-1551 WAR DEPARTMENT,
WASHINGTON, May 4, 1942.

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SECTION I GENERAL

Scope-----	Paragraph
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1. Scope.—This manual is published for the information and guidance of ordnance maintenance personnel. It contains descriptions and detailed instructions for inspection, disassembly, maintenance, and repair of the telescope mounts M21 and M23, panoramic telescopes M5A3 and M12A2, range quadrant M4, elbow telescope M16, and instrument light M5. These instruments constitute the sighting equipment for the 105-mm howitzer carriage M2. The use and operation of these instruments are described in TM 9-325.

SECTION II DESCRIPTION OF MAJOR UNITS

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2. General.—*a. Telescope mount M21.*—(1) The telescope mount M21 is the element of the sighting equipment used for laying the piece in direction.

(2) The mount is of the azimuth-compensating type. It is designed to correct automatically for the error in azimuth resulting from elevating the gun if the trunnions are out of level.

(3) The mount is bracketed to the left side of the cradle and is centered about a prolongation of the cradle trunnion through a centering hole in the bracket.

b. Range quadrant M4.—(1) The range quadrant M4 is the elevation-indicating element of the sighting equipment used with the 105-mm howitzer carriage M2.

(2) The instrument is mounted on a pad on the right side of the cradle so that any movement of the gun in elevation is imparted to the range quadrant.

c. Panoramic telescopes M5A3 and M12A2.—(1) The panoramic telescope M5A3 is a four-power erect-image instrument having a field of view of 10° and an exit pupil of 0.166 inch.

(2) The reticle is provided with a grid scale with the normal or "0" range line through the optical axis of the telescope. The horizontal scale is graduated in mils by 10-mil steps and numbered on each side of the center from 10 to 40. The vertical scale is graduated in hundreds of yards by steps of 200 yards. The divisions are numbered from 200 to 1,200 yards. This type of reticle permits use of the telescope and its mount as a one-sight, one-man laying system which has proved highly effective against moving targets.

(3) The optical and mechanical characteristics of panoramic telescope M12A2 (figs. 11 and 12) are similar to those of the M5A3. Panoramic telescope M12A2 is the standard type. The panoramic telescope M5A3 is used as a substitute. Because of the similarity of these instruments, the operations described herein pertaining to the panoramic telescope M5A3 apply also to the M12A2.

d. Telescope mount M23.—(1) The telescope mount M23 forms the support for the elbow telescope M16. It is mounted on the bracket of the range quadrant M4 by turning the threaded support on the mount into the threaded hole in the upper part of the bracket.

(2) Provisions are made in the mount for adjusting it in elevation and for leveling the reticle lines.

e. Elbow telescope M16.—(1) The elbow telescope M16 is a three-power, erect-image instrument having a field of view of $13^{\circ}20'$ and an exit pupil of 0.30 inch.

(2) It is supported in the telescope mount M23 on the right side of the gun and is used in laying for elevation for direct fire on moving targets.

(3) The reticle is provided with range lines only, with the normal line passing through the optical axis of the instrument. The lines represent elevations for ranges from 0 to 1,600 yards in steps of 200 yards.

(4) The elbow telescope M16 and telescope mount M23 in conjunction with the telescope mount M21 and panoramic telescope M5A3 form a two-sight, two-man system for laying the gun in direct fire against moving targets.

f. Instrument light M5.—(1) The instrument light M5 is provided to illuminate the reticle, micrometers, and indexes of the panoramic telescope and the levels on its mount for night operation. It is clamped to the telescope socket on the mount in such position as not to interfere with the normal operation of the telescope mount. The instrument utilizes two flashlight cells and makes use of the light-transmission properties of a clear plastic to transmit light from a single lamp to the various parts requiring illumination.

(2) No illumination is provided for the reticle in the elbow telescope.

3. Telescope mount M21.—*a. Major units.*—The telescope mount M21 consists principally of the longitudinal leveling mechanism, the azimuth compensating mechanism, and the telescope socket.

b. Longitudinal leveling mechanism.—(1) The longitudinal leveling mechanism consists of the bracket (D29351) and rocker (D29352, fig. 2) and the longitudinal leveling worm (B139096, fig. 3).

(2) The bracket is bolted to the cradle and is the support for the telescope mount. Any motion of the piece in elevation is carried through the bracket, which also forms the longitudinal leveling worm housing, to the worm gear segment, causing the mount to rotate with the gun. (See fig. 2.)

(3) The rocker rotates about a bearing on the bracket and carries with it the cross leveling worm housing (C56921).

(4) Gear teeth on the rocker engage the longitudinal leveling worm housed in the bracket (fig. 3). It is by this means that rotation of the mount body (D29385, fig. 4) carrying the telescope socket is restrained and the longitudinal leveling motion imparted. This motion is controlled by the longitudinal leveling knob (A179581, fig. 3).

(5) A longitudinal level (11, fig. 31) is provided for indicating the position where the vertical axis of the telescope socket (8) is parallel

to a vertical plane passing through the gun trunnion axis. In this position the line of sighting is horizontal if the elevation indexes of the panoramic telescope are set to normal.

c. Cross leveling mechanism.—(1) The cross leveling mechanism consists of the cross leveling segment (B136511, fig. 2) and the cross leveling worm (A179580).

(2) The gear teeth on the cross leveling segment engage the cross leveling worm contained in the housing (C56921) attached to the rocker (D29352). The mount body (D29385, fig. 4) is restrained from rotating about the axis of the bearing (C56766, fig. 2) and actuating arm (C77669) by a stud on the cross leveling segment which is inserted into a lug in the body. It is through this stud that the cross leveling motion is imparted to the body carrying the telescope socket (D29386, fig. 4).

(3) A cross level (12, fig. 31) is provided to indicate the position of the telescope socket when its axis is parallel to the vertical plane passing through the bore of the gun.

d. Azimuth compensating mechanism.—(1) The compensating mechanism consists of the actuating arm (C77669), bearing (C56766, fig. 2), and pivot (A45330, fig. 4).

(2) The actuating arm and the hole in bracket have keyways cut in their surfaces to receive a key.

(3) By means of the key, any motion of the gun in elevation will cause the actuating arm to rotate in a like amount and cause the pivot to remain parallel to the gun at all times.

(4) The actuating arm supports the bearing by means of the pivot (sec. D-D, fig. 4). It is about this pivot that the cross leveling mechanism is centered. The combination of the pivot, actuating arm, and the stud, mentioned in *c*(2) above, form a universal joint which is the essential mechanism causing the motion giving the azimuth correction.

(5) As the mount is leveled longitudinally, the mount body is forced to rotate about the stud, thus automatically applying the azimuth correction to compensate for the error ensuing when the gun is elevated with the gun trunnion out of level.

e. Telescope socket.—(1) The telescope socket (D29386, fig. 4) is provided with tangent screws (A46233, sec. B-B, fig. 4) for use in collimating the telescope, and a retaining shaft (B129074, sec. C-C, fig. 4) actuated by a wing knob (A37322) for locking the telescope securely in the socket.

(2) The socket is offset 45° to accommodate panoramic telescope M5A3 in such manner that the line of sighting will be parallel to

the bore of the gun when the telescope and the mount are in adjustment.

(3) The top of the socket is accurately machined to form a surface at right angles to the vertical axis of the socket as a locating surface for the telescope. It is also used as a test level seat in checking the adjustment of the levels.

4. Range quadrant M4.—*a.* The range quadrant M4 consists of four major units: the cross leveling mechanism, the elevation mechanism, the angle of site mechanism, and the illuminating system.

b. Cross leveling mechanism.—(1) The mounting bracket (23, fig. 34) which supports the range quadrant is bolted to a pad on the gun cradle ahead of and above the right trunnion. The quadrant body (D43325, fig. 6) is pivoted to the bracket by means of a shaft (A179624) and is caused to rotate on the shaft by the cross leveling mechanism.

(2) The cross leveling worm (B139107, sec. D-D, fig. 6) is housed in the lower part of the mounting bracket, and a stud on the gear segment (B139108, sec. G-G, fig. 6) fits into a lug in the lower part of the quadrant body. It is through this medium that the cross leveling motion is imparted to the instrument.

(3) A cross level (27, fig. 34) is provided to indicate the position when the vertical axis of the quadrant is parallel to the vertical plane passing through the axis of the bore.

c. Elevation mechanism.—(1) The elevation worm (B139109, sec. A-A, fig. 7) is housed in the upper part of the quadrant body. It engages the teeth on the elevation gear (C77685, sec. D-D, fig. 6), which is supported by a set of ball bearings mounted on a cylindrical portion of the body.

(2) When the gear is rotated by turning the elevation worm knob (A179614, fig. 7) or range knob (A179622) on the elevation worm, it carries with it the angle of site worm (A177756, sec. F-F, fig. 6), the angle of site scale index (33, fig. 34), the angle of site level (26), and the cross level (27).

(3) The elevation micrometer (A178601, fig. 7) is graduated into 100 equal spaces, each representing 1 mil, and is for use with the elevation scale, the graduations of which are in increments of 100 mils, the 0 graduation indicating the normal.

(4) Three range drums (D43144, D43145, and D43146 for zones of fire VII, III, and V, respectively), bearing range graduations for high explosive shell, are supplied with each instrument. A spiral groove on the drum surface causes the range pointer (35, fig. 34) to move along its surface to indicate the range corresponding to the

elevation registered on the elevation scale when the drum is properly assembled to the mount. The drum is mounted on two adapters (A179634 and A179635, fig. 7) which in turn are pinned to the elevation worm (B139109). A lug on the drum and a slot in the rim of the forward adapter (A179634) provide a means for rapid location of the drum with respect to the elevation scale and micrometer, and a knob (A179622) and nut (A179636) at the end of the worm shaft effectively lock the drum in position.

d. Angle of site mechanism.—(1) The angle of site worm (A177756 sec. F-F, fig. 6) engages a second segment on the elevation gear (C77685). Since the gear is restrained by the elevation worm, rotation of the angle of site worm causes its housing to rotate on a bearing on the gear, carrying with it the cross level (27, fig. 34), the angle of site level (26), and the angle of site scale index (33).

(2) The angle of site level is provided to indicate when the gun is laid to the elevation set on the scales and micrometers on the range quadrant.

(3) The angle of site micrometer (A179625, sec. F-F, fig. 6) is graduated into 100 spaces, each representing 1 mil. It is for use with the angle of site scale which is graduated in increments of 100 mils and numbered from 1 through 6. The normal indication on the angle of site scale is 3 (fig. 34).

e. Illuminating system.—(1) The range quadrant M4 is provided with a system for illuminating the elevation scale, angle of site scale, micrometers, range drum, and levels for night operation.

(2) Four Signal Corps flashlight cells, type BA-30, from which power is drawn to illuminate the various parts, are contained in the battery box (48) in the mounting bracket (23).

(3) The cross level and angle of site level are illuminated directly by a lamp in the elbow of the level housing. (See sec. C-C, fig. 7.)

(4) Light is carried to the elevation scale and elevation scale index from the lamp in the elbow of the level housing through a tube (72, fig. 34) filled with a clear plastic.

(5) Light is carried from the same source through another tube (73) to illuminate the angle of site scale, angle of site index, and angle of site micrometer.

(6) The range drum is illuminated by light emitted from a rod of clear plastic contained in a slotted tube above it. The source of light is a lamp in the bracket (B139112, sec. A-A, fig. 7) at the left end of the drum.

(7) The elevation micrometer is illuminated by light from the lamp in the above-mentioned bracket carried to it through a tube (74, fig. 34).

5. Panoramic telescope M5A3.—*a. Major units.*—The panoramic telescope M5A3 may be divided into the following major units to facilitate description:

- (1) The rotating head and related mechanisms.
- (2) The dove prism and related mechanism.
- (3) The elbow, together with the parts it supports.

b. Rotating head and related mechanism.—(1) The elevation worm (B138603, fig. 10) housed in the rotating head engages the teeth out in the prism holder (B136040). The prism holder contains the field prism (B16463). Rotation of the worm by means of the elevation knob (A49927) causes the field prism to rotate in the vertical plane through the line of sighting. A window (A45493), mounted in front of the prism, excludes dust and moisture from the optical system and internal mechanism.

(2) An open sight (A45482, sec. D-D, fig. 9) is attached to the rotating head cover (A45485) in such position that the line of sighting through it will be horizontal when the mount is leveled.

(3) Due to the rotation of the field prism in the vertical plane, the field rays will be incident to the reflecting surface of the prism at angles other than the angle of total reflection. In order to prevent the consequent loss of light, the reflecting surface is silvered.

(4) The rotating head is fastened to the azimuth worm gear (C44753, fig. 10), which engages the azimuth worm (B136083, fig. 9) in the azimuth worm housing (C56723, fig. 10). The azimuth scale is a circular scale divided into two consecutive semicircles, each graduated in intervals of 100 mils. The graduations on each semicircle read from 0 to 3,200 mils.

(5) Lateral motion of the rotating head is controlled by means of the azimuth knob (A45461, fig. 9) which is pinned to the azimuth worm. An index is mounted on the opposite end of the azimuth worm shaft and indicates the azimuth setting on the micrometer scale, which is engraved on the micrometer knob (B136079). The fixed index (A45468) is also used with the micrometer knob.

(6) The micrometer is graduated into 100 spaces, each representing 1 mil, and reads from 0 to 100 in both clockwise and counter-clockwise directions. To avoid confusion, the two groups of numbers are contrastingly colored.

(7) The worm release lever (A45479) actuates the cam and plunger arrangement shown in section B-B, figure 9, and thereby disengages the azimuth worm and worm gear. This feature permits rapid adjustment of the azimuth setting. The worm and gear are so constructed that they will engage only at intervals of 100 mils;

therefore, the relation between the micrometer setting and azimuth scale setting is not affected by such an adjustment.

c. Dove prism and related mechanism.—(1) The dove prism (B16464, fig. 10), which is supported within the sleeve (A45473) by the holder (B129681), is provided to eliminate the falling or tilting of the image which would otherwise occur when the rotating head is rotated about its vertical axis.

(2) The reflecting surface of the dove prism acts as a reflecting mirror in such manner that as the prism is rotated about its vertical axis through a given angle, the image will be rotated about its horizontal axis through twice the angle. The dove prism is therefore geared to the field prism so that the former is rotated about the vertical axis through one-half the angle of rotation of the latter and the image remains erect at all times.

(3) This gearing consists of a spur gear cut on the inner hub of the azimuth worm gear, two spur pinions (B136081A and B136081B), and a spur gear which is cut near the upper end of the sleeve (A45473).

d. Elbow and related parts.—(1) The telescope elbow (C44432A, fig. 10) houses the Amici prism (A36234), the eyepiece assembly (C77666), and the diaphragm (A39410) and supports the cell (B16515) containing the objective (A36359) in the upper end of its vertical leg.

(2) The eyepiece assembly consists of the field lens (A49896, fig. 15), the eyelens (A49895), the reticle (B139072), and the necessary mechanical parts.

(3) Cross lines are etched on the reticle (fig. 16) with the normal line on the horizontal cross line and the "0" deflection line on the vertical cross line. The deflection scale is graduated in mils and numbered by 10's from zero to 40 each way from the zero line. The range scale is graduated in hundreds of yards and numbered by 2's from zero to 12.

(4) The shutter (A45488, fig. 10) when set at the open position, permits illumination of the reticle through a small window set into the elbow.

(5) The soft rubber eyeshield (A39125) is of the conventional type and is slipped over the end of the eyepiece assembly.

(6) The lugs on the shank (C44433A, fig. 10) engage the tangent screws and retaining shaft, respectively, in the socket of the telescope mount. The collar (A38063) at the bottom of the elbow fits into a recess in the bottom of the socket.

6. **Telescope mount M23.**—*a. Major units.*—The telescope mount M23 consists of the support (B139285, fig. 18), housing (C77791), rotating bracket assembly (B139366), and the parts pertaining to them.

b. Support.—(1) The support (B139285) is threaded and is assembled to the mounting bracket (23, fig. 34) of the range quadrant M4 by turning it into the threaded hole in the upper part of the bracket and securing by means of a tapered pin. When assembled in this position the support is parallel to the gun trunnion and therefore perpendicular to the gun.

(2) Gear teeth cut on the support are engaged by the elevation adjusting worm (A179762), permitting 360° rotation of the housing (C77791) on the support.

(3) A semicircular groove machined on the circumference of the support provides clearance for the clamping bolt (BCAX1EK).

(4) The outer end of the support is threaded to accommodate a locking nut (A178126) which, when tightened and pinned by the screw (BCUX2PC), holds the housing in position on the support.

c. Housing.—(1) The housing contains the clamping bolt (BCAX1EK), the bracket rotating worm (B139284), the elevation adjusting worm (A179762), and also forms the support for the rotating bracket (C77792).

(2) The elevation adjusting worm engages the gear teeth on the support and since the support is rigid, rotation of the worm causes the housing to rotate in a vertical or nearly vertical plane parallel to the bore of the gun, carrying the bracket with it. The worm is used in adjusting the telescope in elevation with respect to the bore of the gun.

(3) The clamping bolt passes through the split part of the housing and is used for clamping the housing around the support. This is necessary to eliminate the possibility of loss of collimation resulting from backlash or accidental rotation of the worm.

(4) The bracket rotating worm, actuated by the knob (A34051), engages the gear teeth cut on the trunnion of the rotating bracket (C77792). Rotation of the worm causes the telescope to rotate about its objective axis.

d. Rotating bracket assembly.—(1) The trunnion on the bracket (C77792) fits into a bearing in the housing (C77791) and is secured in position by a threaded plug (A179763), which is locked to the trunnion by means of a screw.

(2) The other end of the bracket is provided with a clamp (B137471) which fits around the telescope body. When the telescope

is placed in the bracket a flat locating surface on the telescope engages a similar surface on the bracket so that when the clamp is tightened the telescope is held rigidly.

(3) The bracket is constructed in such way that the vertical plane through the line of sighting is parallel to the vertical plane through the axis of the gun bore.

7. Elbow telescope M16.—*a. Major units.*—The elbow telescope M16 consists principally of the optical system (figs. 20 and 21) and the body (D43398, fig. 19) with its attached parts including the eyeshield (B135751), adapter (B135750), and covers.

b. Body.—(1) The telescope body is an L-shaped tubular brass casting, the legs of which are approximately 3 and $3\frac{1}{2}$ inches long and $1\frac{3}{4}$ inches in diameter.

(2) A bearing surface which is clamped into the rotating bracket on the mount is machined on the shorter leg. A flat locating surface to match the locating surface on the mount is machined on the leg adjacent to the bearing.

(3) The adapter to which the soft rubber eyeshield is clipped is so constructed that it can be disengaged from the groove in the body, thus allowing it to slide along the tube until the end of the eyeshield is flush with the end of the tube.

(4) The covers (B173419, fig. 19) screw into the sides of the telescope elbow and are locked by screws.

c. Optical system.—(1) The optical system consists of the two lenses (A45960) contained in the cell (B136408) and the eyepiece assembly; the reticle (C78161) contained in the cell (A45967) in front of the eyepiece assembly; the Amici prism (A36234) secured in the elbow of the telescope by means of the holder (A37820) and the wedge (A37821); and the objective lens (A45963) contained in the cell (B136409) near the front end of the telescope tube.

(2) The lenses and reticle are retained in their respective cells by means of threaded rings and lock screws. The cells in turn are threaded into the telescope body and held securely by means of locking screws. This method of assembling obviates the possibility of the parts working loose during use.

(3) The reticle (fig. 21) has etched on it nine range lines representing elevations for ranges by 200-yard steps from zero to 1,600 yards. The zero range line passes through the optical axis of the telescope. Two rows of figures facilitate tracking the target by lessening the possibility of the target's getting undesirably far from the figures designating the range lines.

8. Instrument light M5.—*a. General.*—The instrument light M5 is used with the panoramic telescope M5A3 and telescope mount M21 to illuminate the reticle, azimuth scale, and azimuth micrometer of the telescope, and the cross level and longitudinal level on the mount (fig. 24).

b. Description of parts.—(1) The body (C77749, fig. 22), of the instrument is firmly held against the telescope socket by the two clamps (A180694 and A180695) in such position that the horizontal leg of the telescope fits into the semicircular notch in the lamp housing (C78637).

(2) Two Signal Corps BA-30 type flashlight cells providing power for the 3-volt lamp are contained in the battery tube (B139195). A toggle switch is built into the bottom cover of the tube. (See sec. A-A, fig. 22.)

(3) Two tubes (A179241 and B138711) contain rods of a clear plastic which possesses the characteristics of being able to transmit light along its length with slight loss, provided that the rod is uniform in cross section and highly polished.

c. Illuminating system.—(1) The reticle of the telescope is illuminated directly by the lamp through a window in the horizontal leg of the telescope. A shutter on the leg of the telescope covers the window when the light is not in use.

(2) Light transmitted through a tube (B138711) illuminates the azimuth micrometer on the telescope. A part of the tube is cut away near its upper end and exposes the plastic rod, which is lightly sandblasted at that point, causing light to be diffused on the azimuth scale.

(3) The longitudinal level on the telescope mount is illuminated by light transmitted through the tube (A179241) from the lamp in the lamp housing. The cross level is illuminated directly by the lamp through a hole in the bottom of the lamp housing.

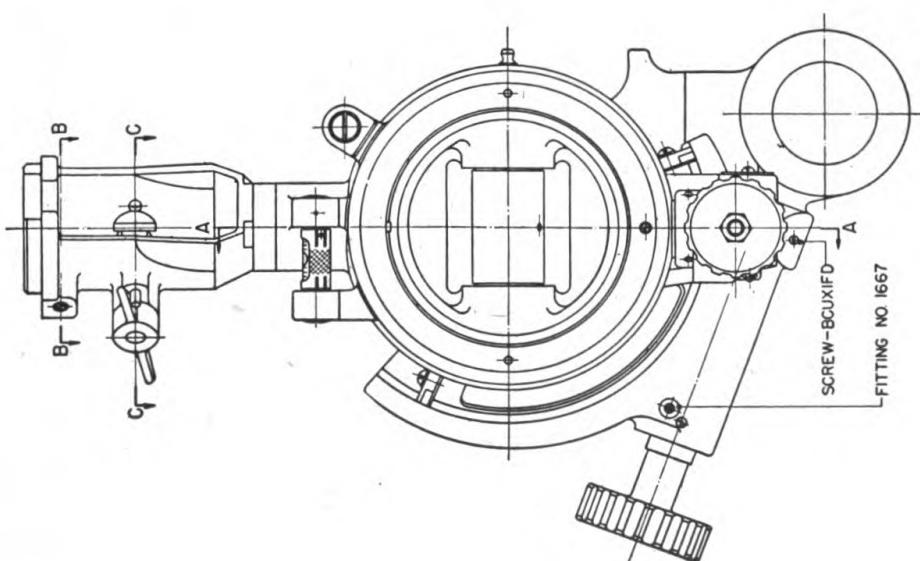
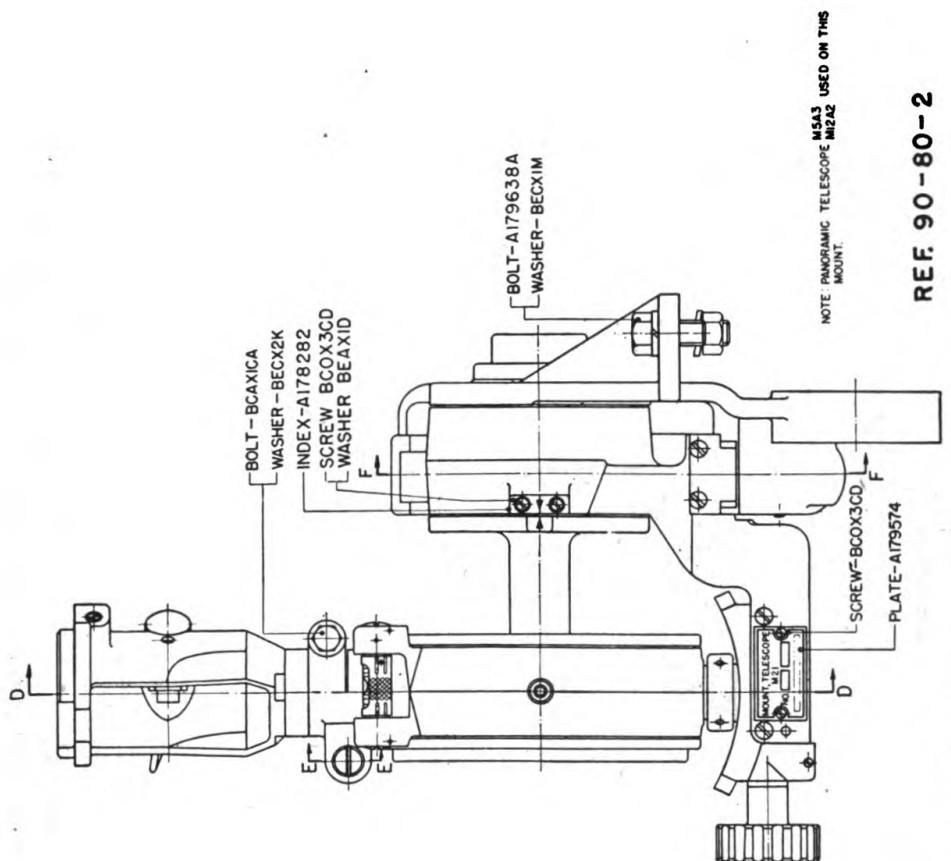


FIGURE 1.—Telescope mount M21, assembled views.

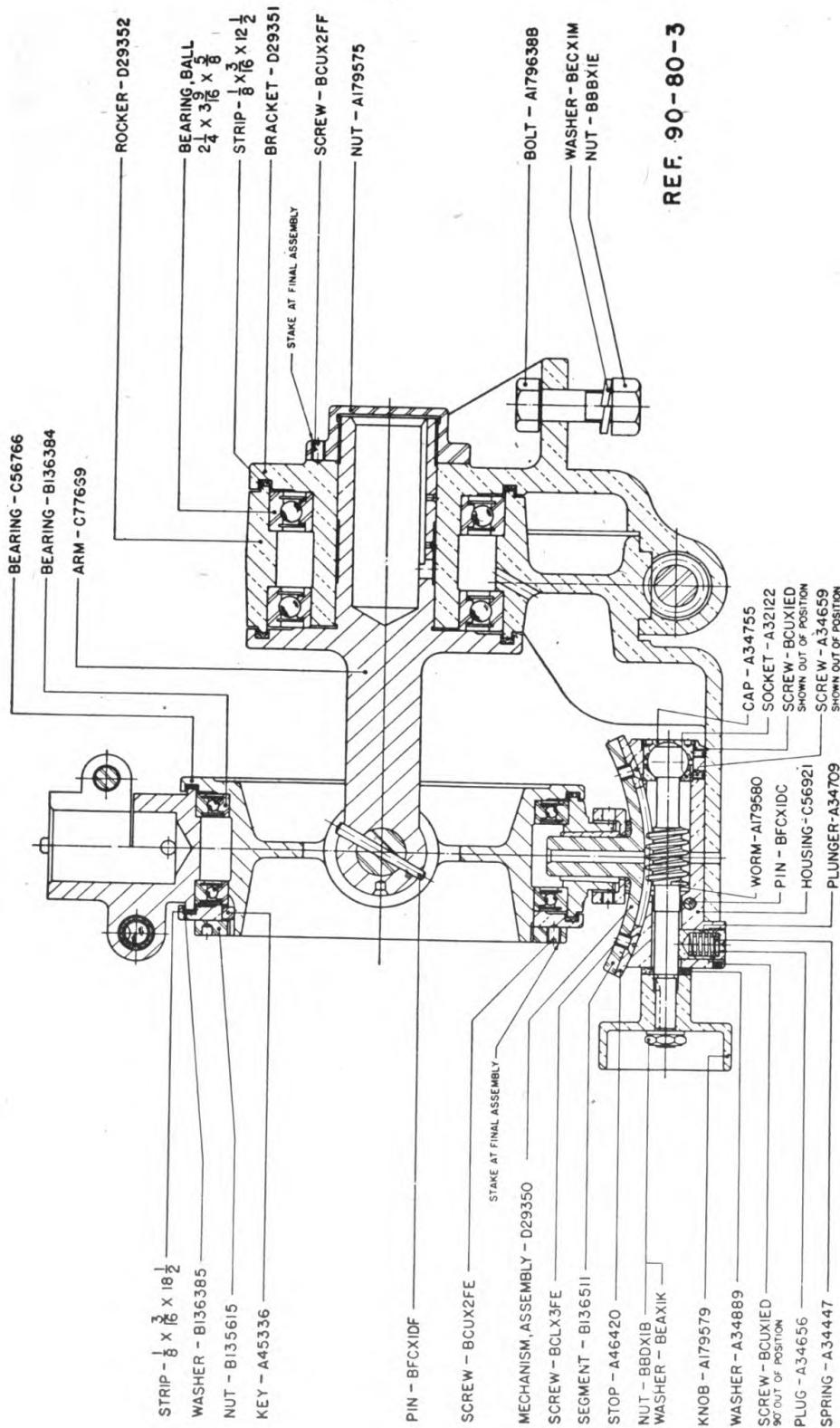


FIGURE 2.—Telescope mount M21, sectional view A-A.

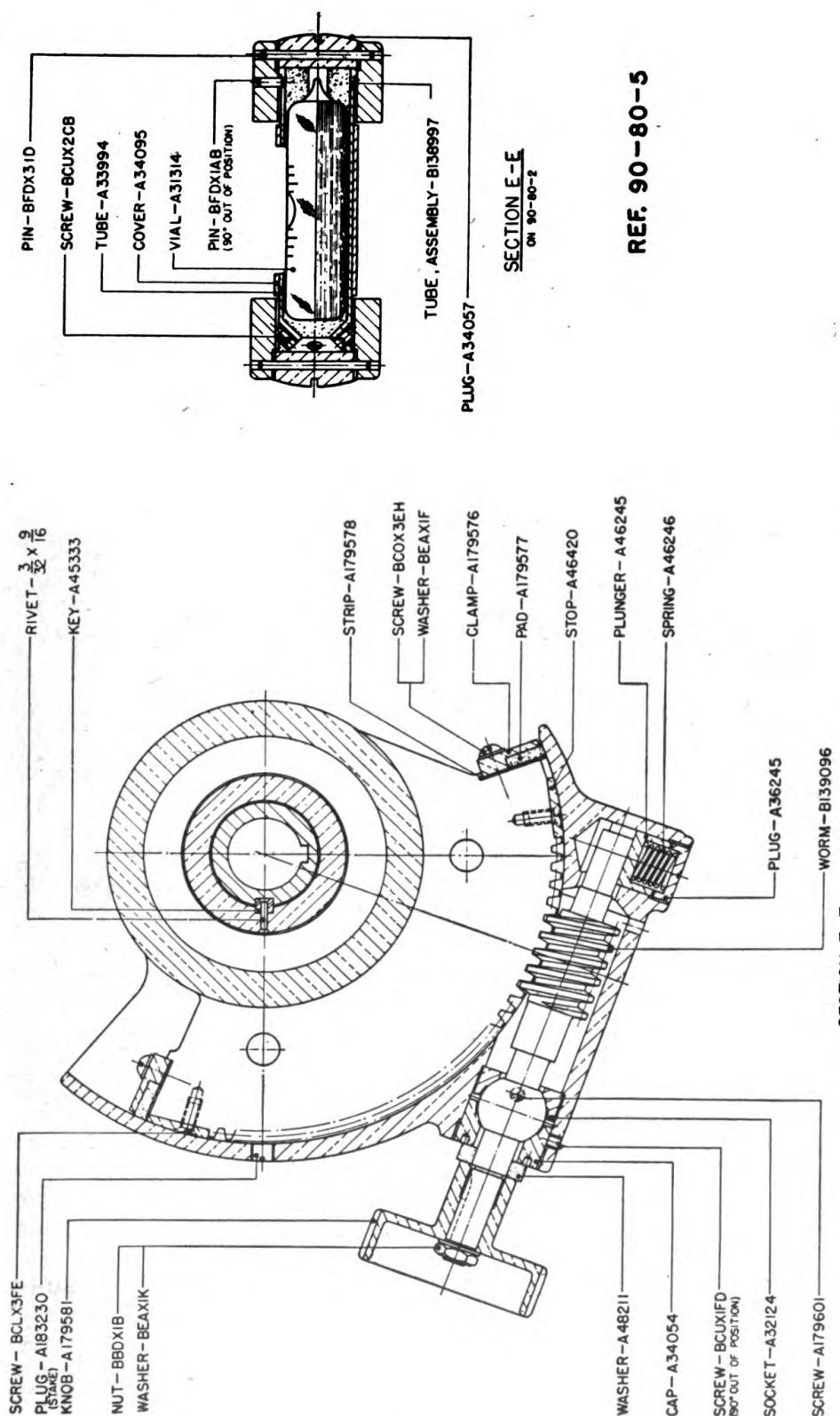


FIGURE 3.—Telescope mount M21, sectional views E-E and F-F.

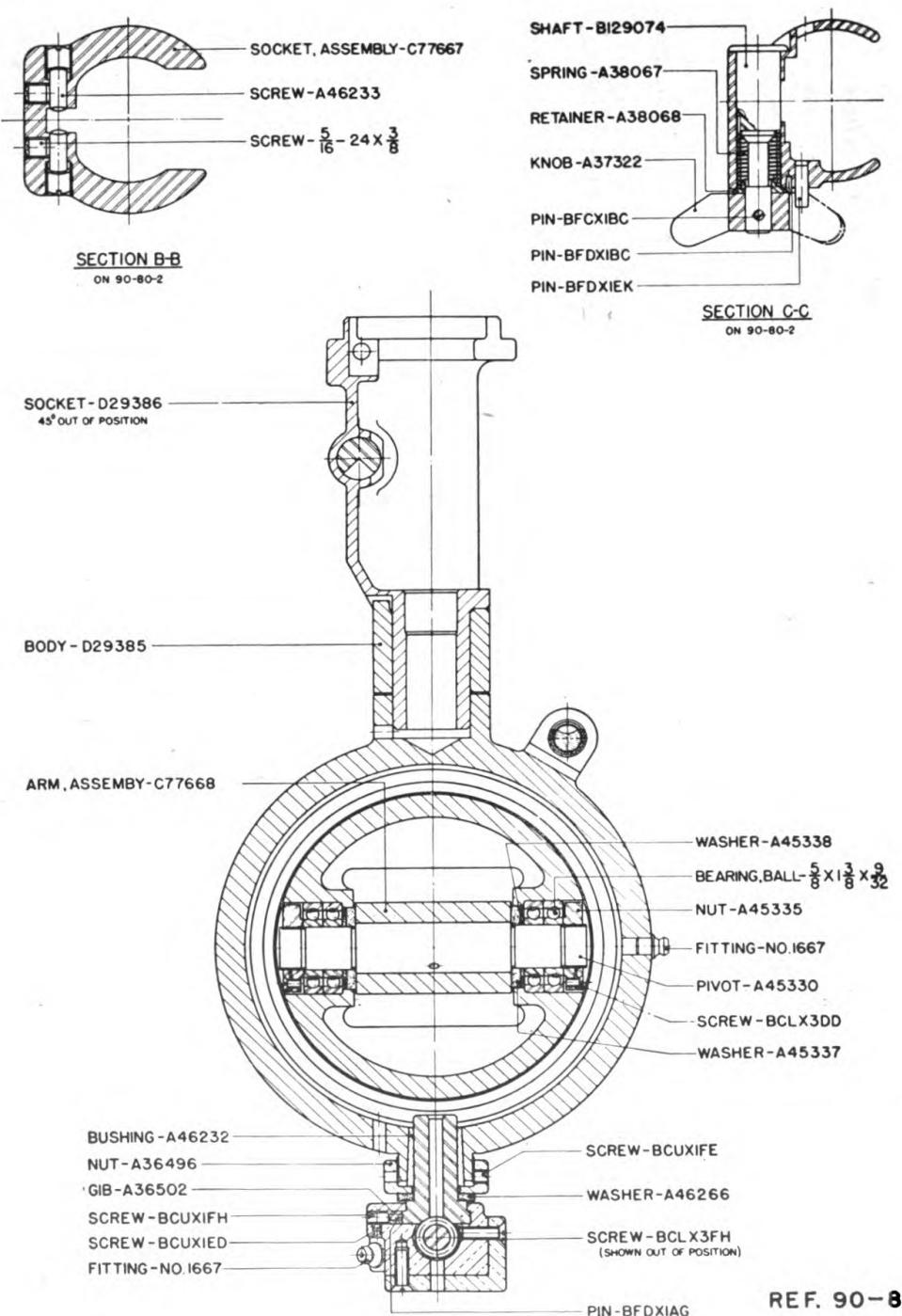


FIGURE 4.—Telescope mount M21, sectional views B-B, C-C, and D-D.

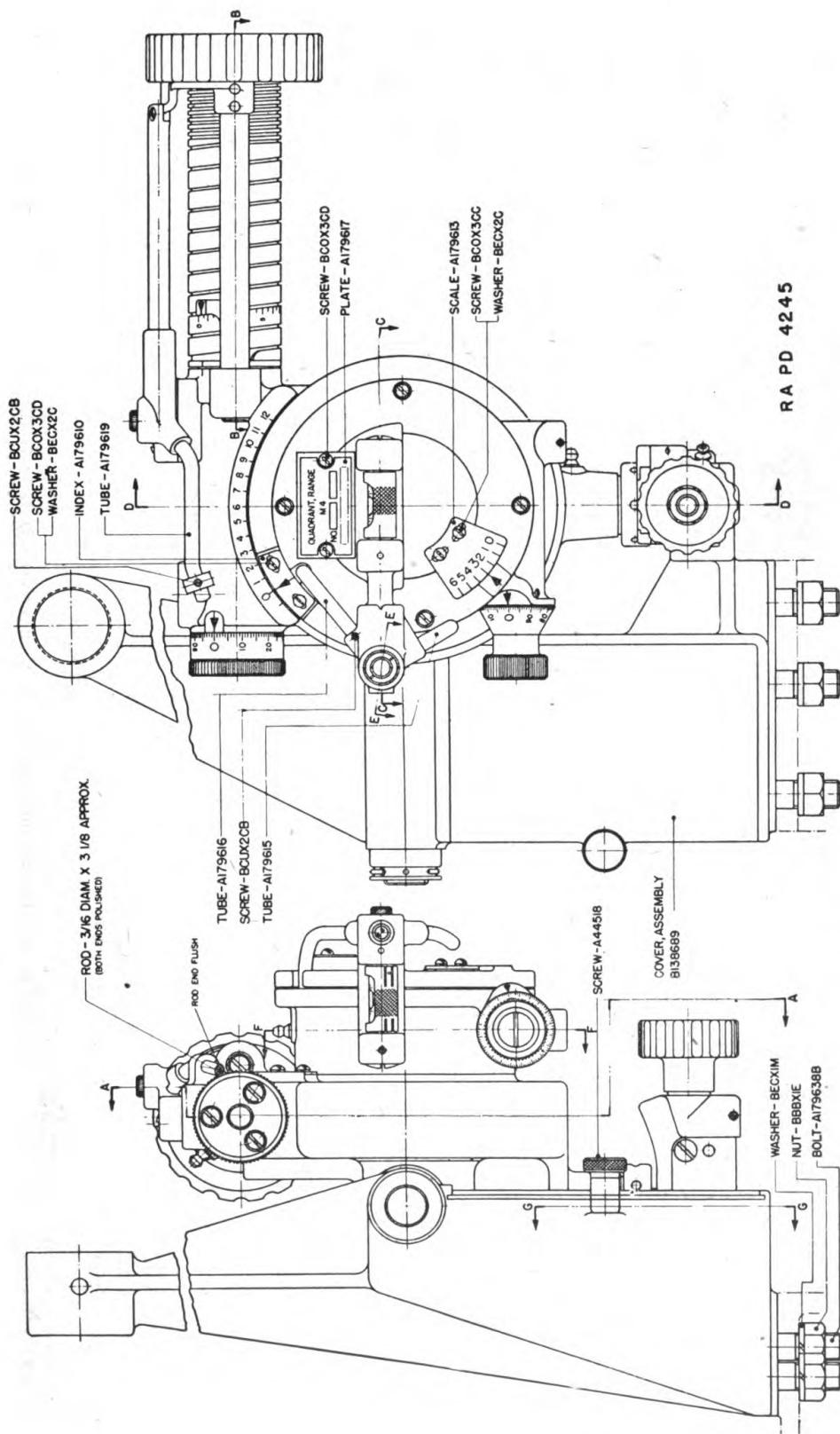


FIGURE 5.—Range quadrant M4, assembled views.

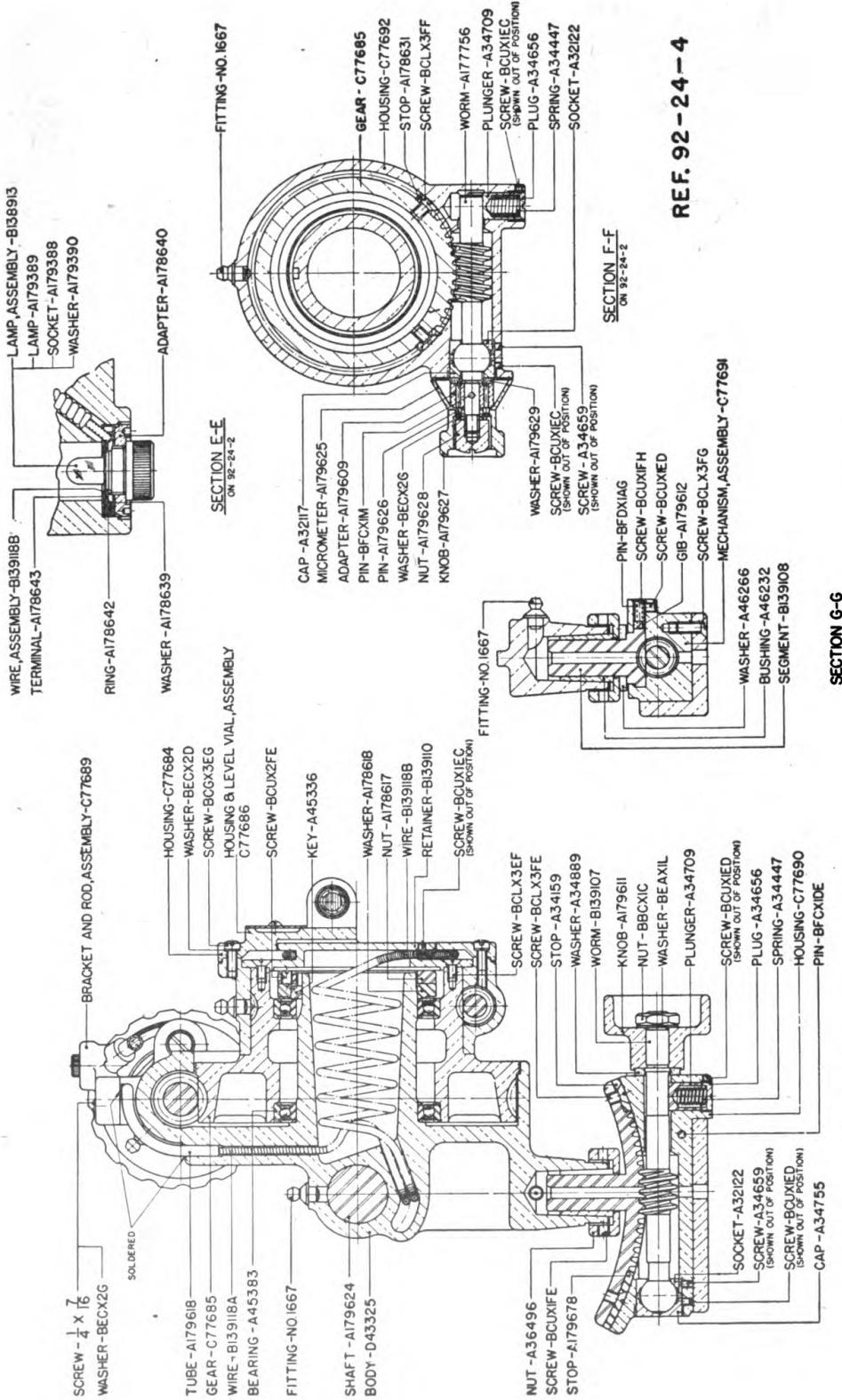


FIGURE 6.—Range quadrant M4, sectional views D-D to G-G.

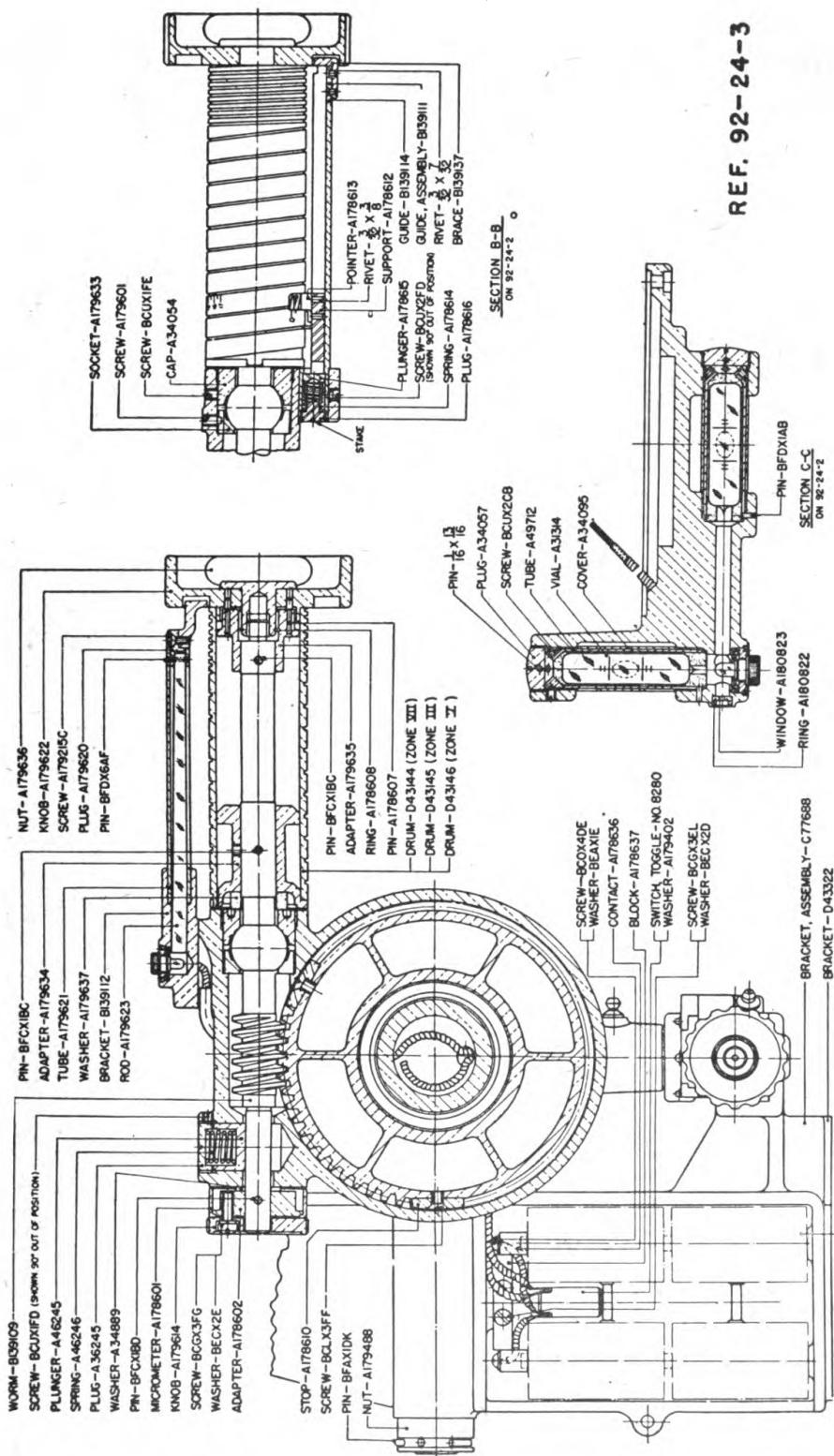


FIGURE 7.—Range quadrant M4, sectional views A-A to C-C.

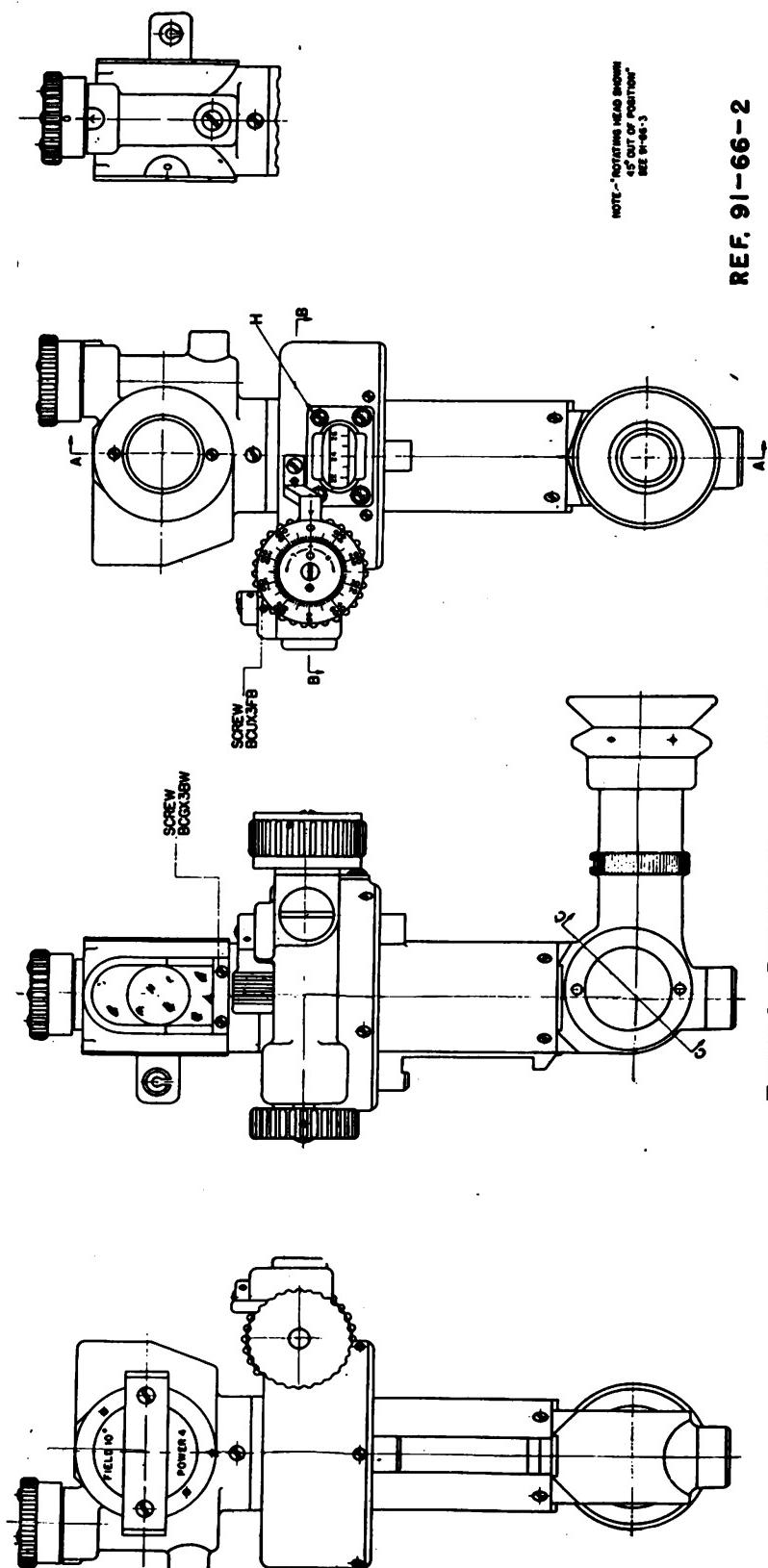


FIGURE 8.—Panoramic telescope M5A3, assembled views.

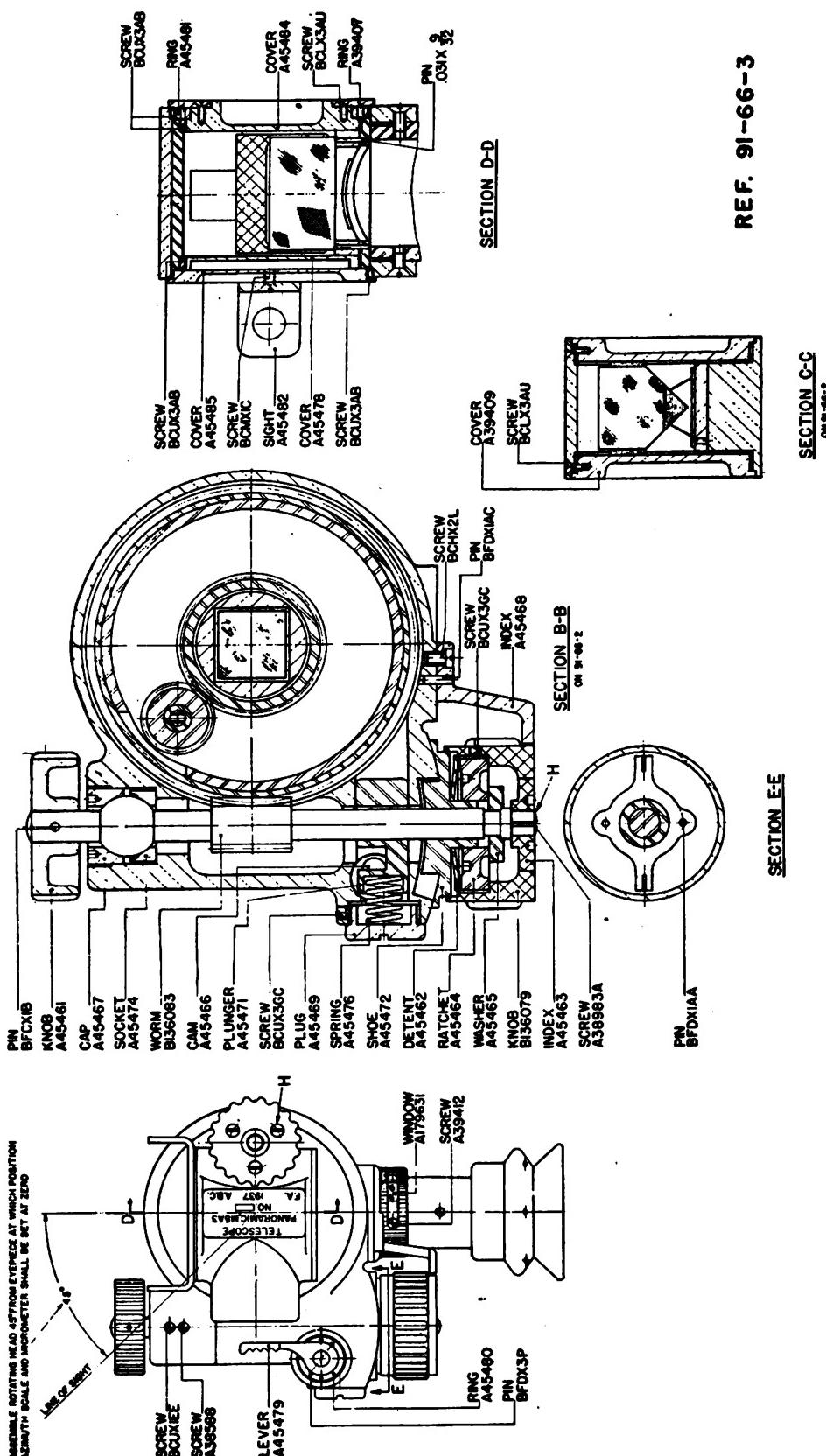
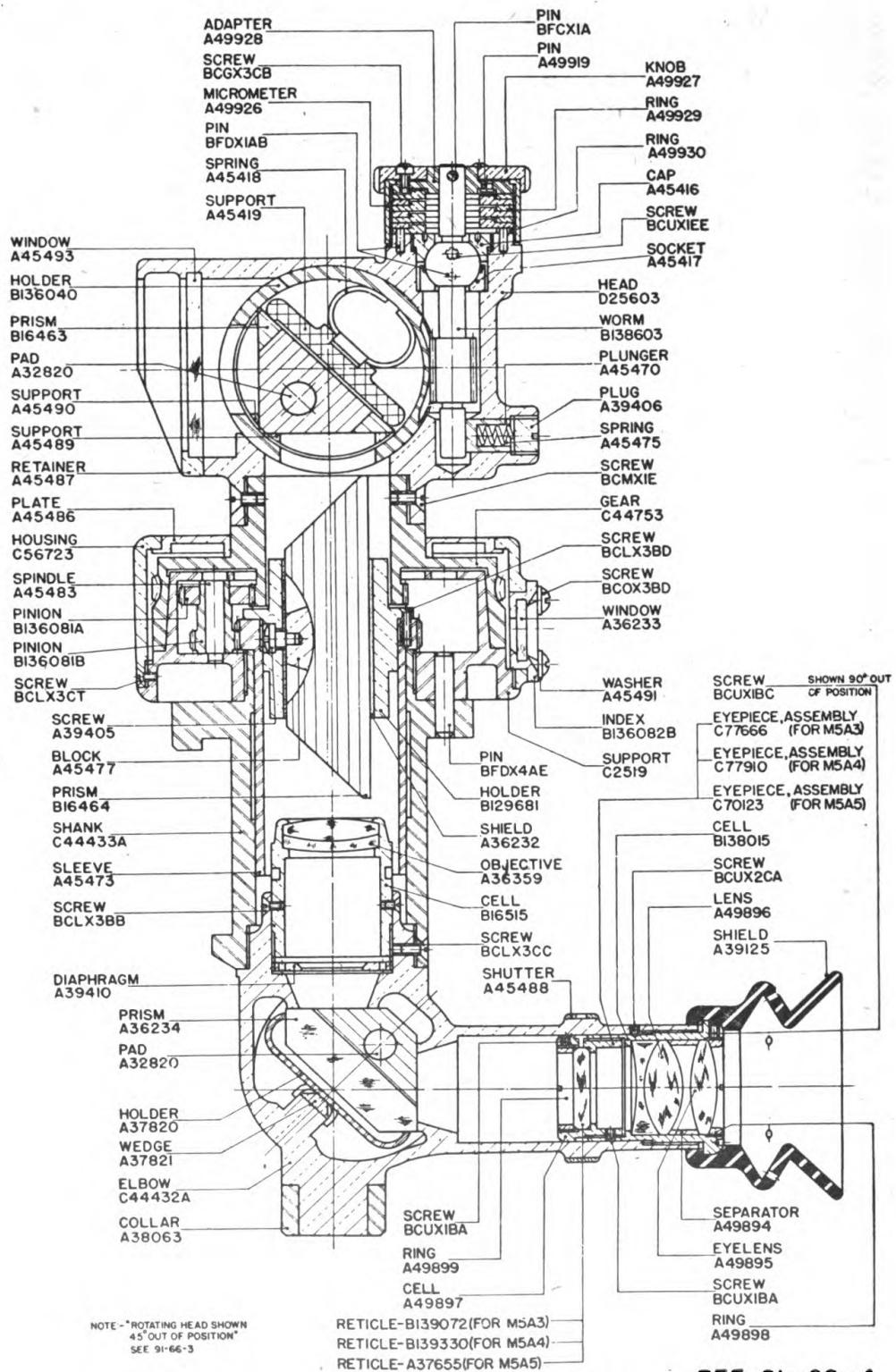


FIGURE 9.—Panoramic telescope M5A3, sectional views B-B to E-E.



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SECTION A-A
ON 91-66-2

FIGURE 10.—Panoramic telescope M5A3, sectional view A-A.

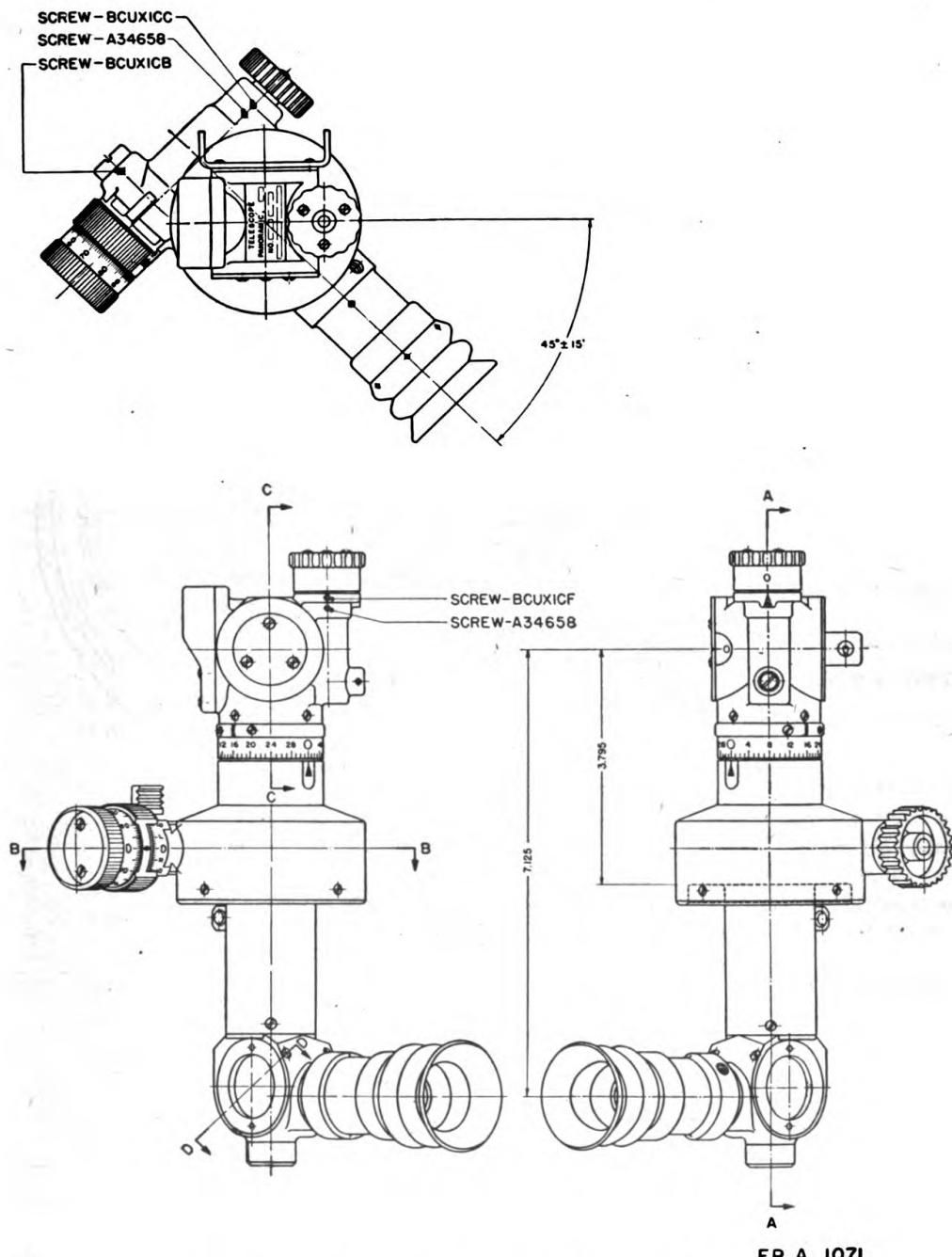
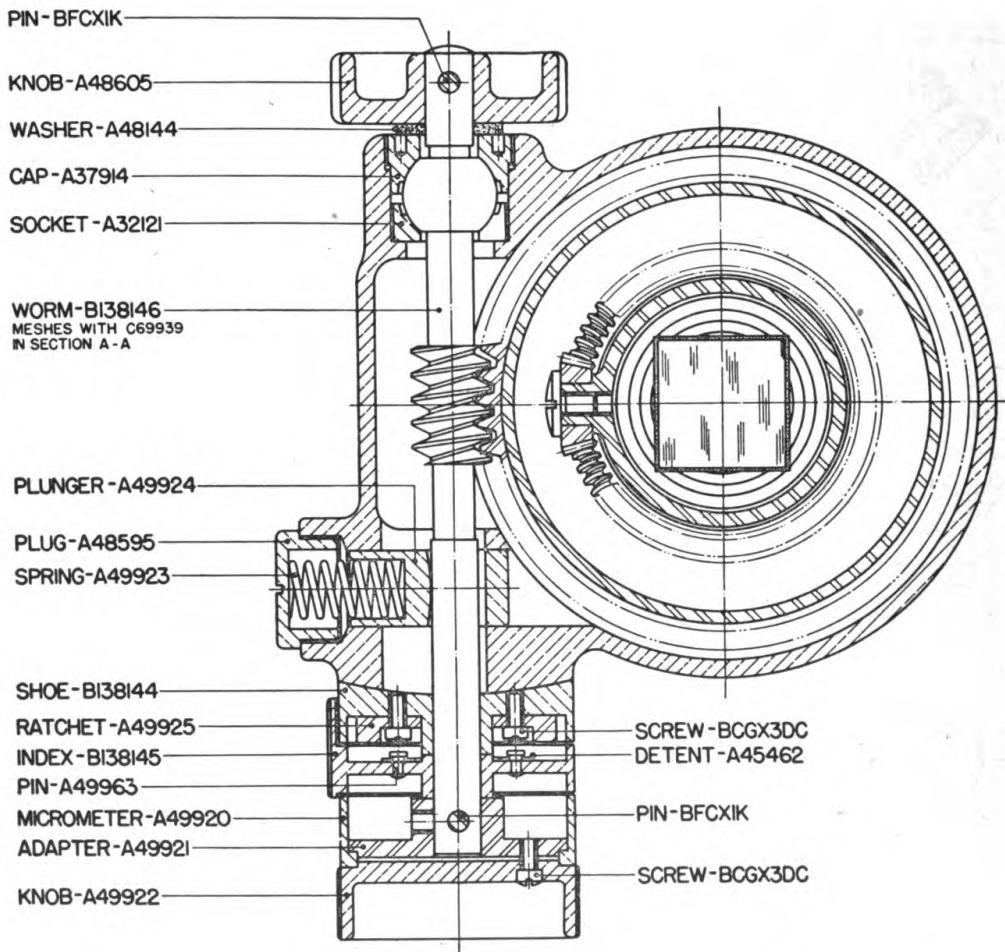
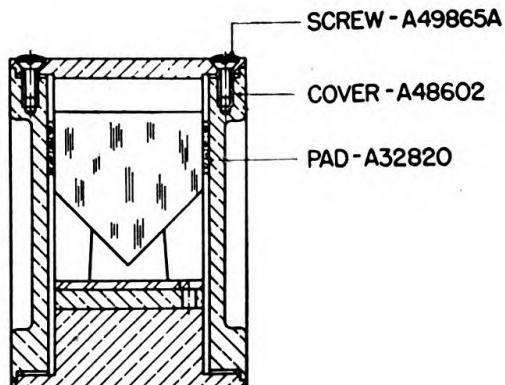
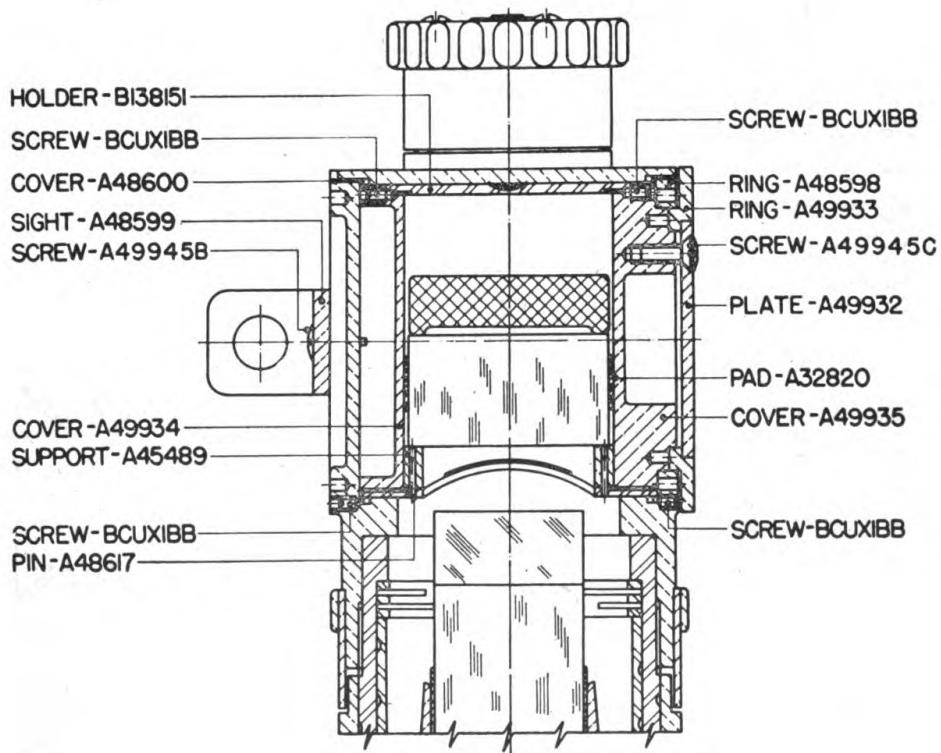


FIGURE 11.—Panoramic telescope M12A2, assembled views.

SECTION B-B

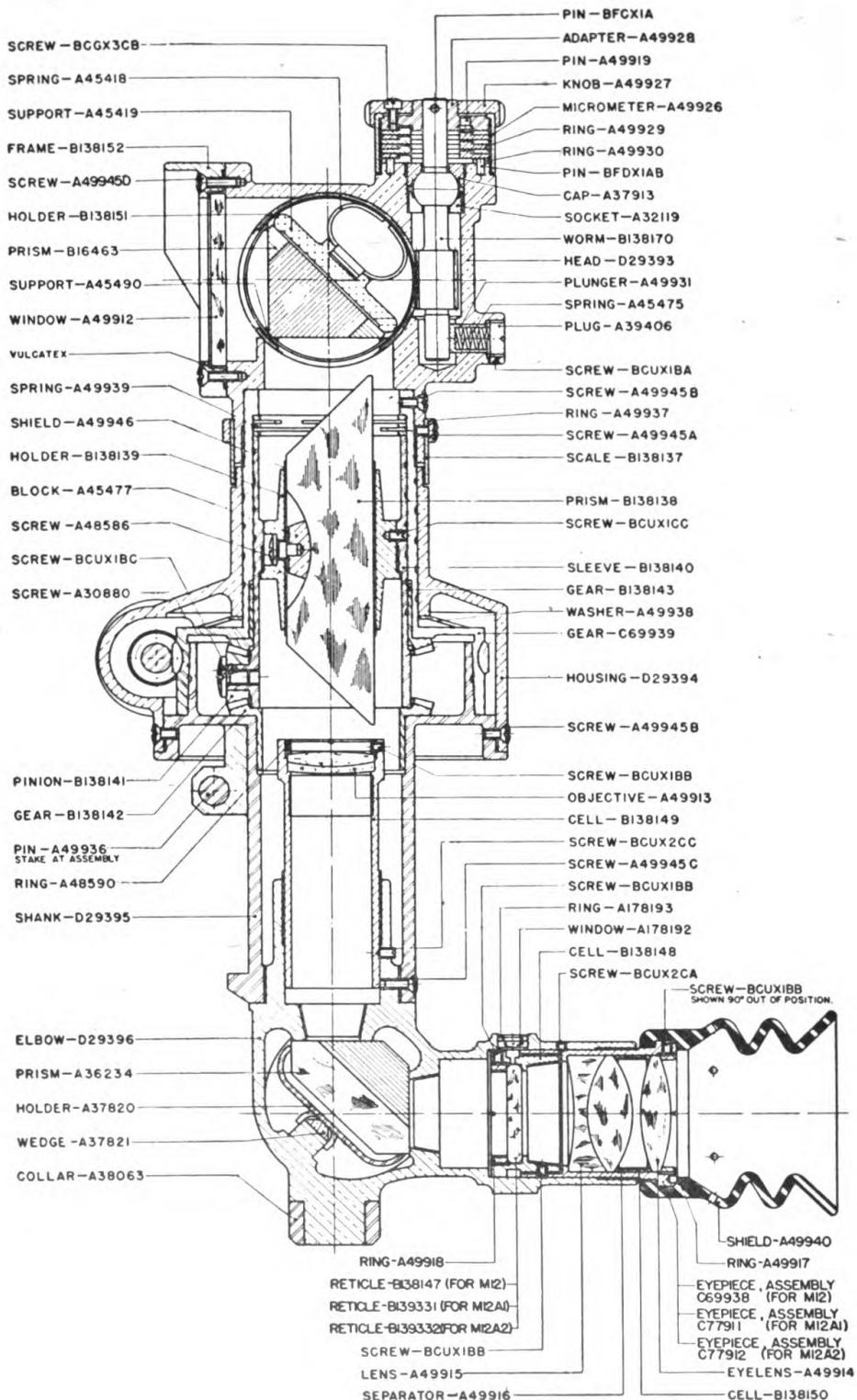
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FIGURE 12. -Panoramic telescope M12A2, sectional view B-B.

SECTION D-DSECTION C-C

RA PD 4651

FIGURE 13.—Panoramic telescope M12A2, sectional views C-C and D-D.



SECTION A-A

F.R.A. 1073

CHARACTERISTICS

Power-----	4X	Diameter of exit pupil-----	0.166
E. F. L. of objective-----	3.135	Eye distance-----	0.74 (clear)
E. F. L. of eyepiece -----	0.788	Field of view-----	10°

FIGURE 14.—Panoramic telescope M12A2, sectional view A-A.

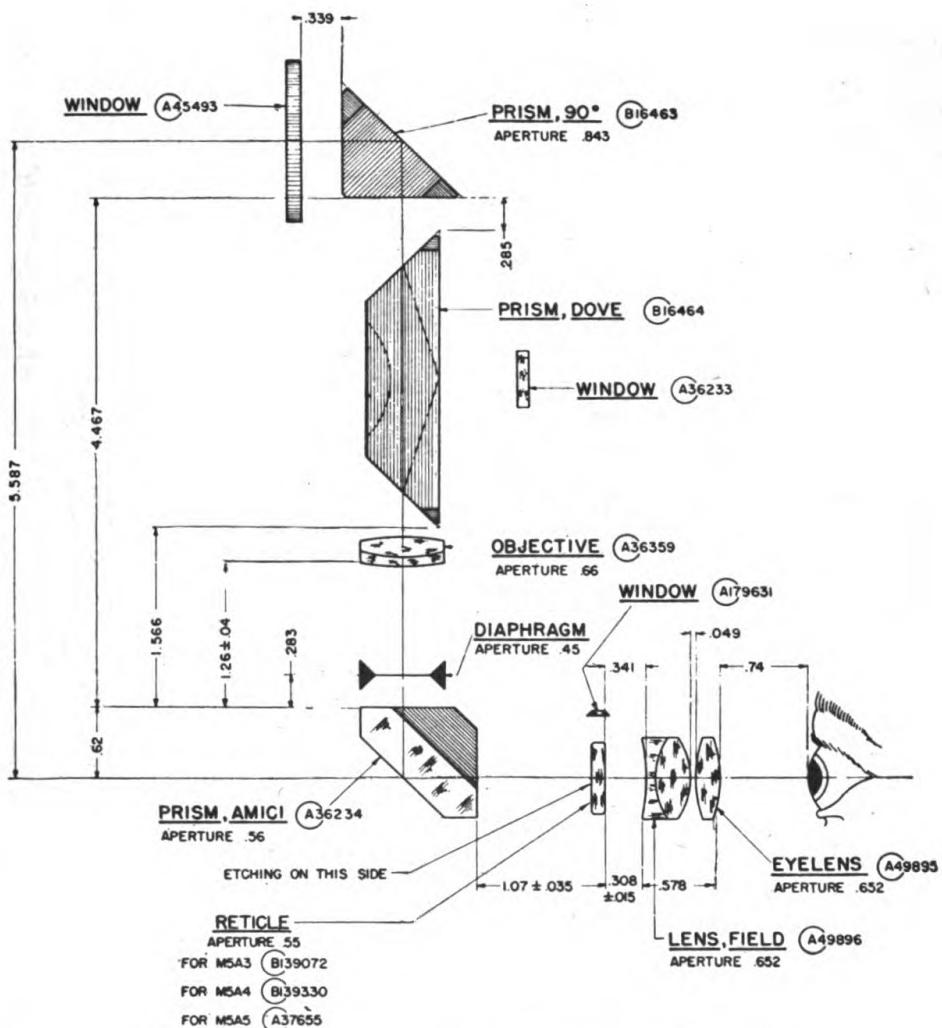


FIGURE 15.—Panoramic telescope M5A3, optical system.

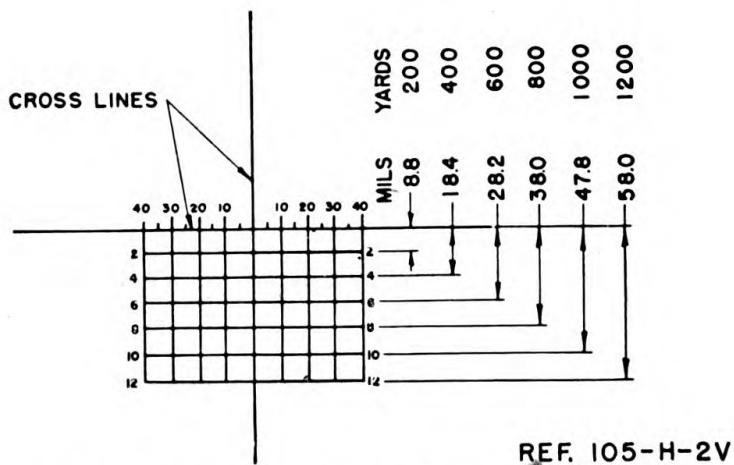
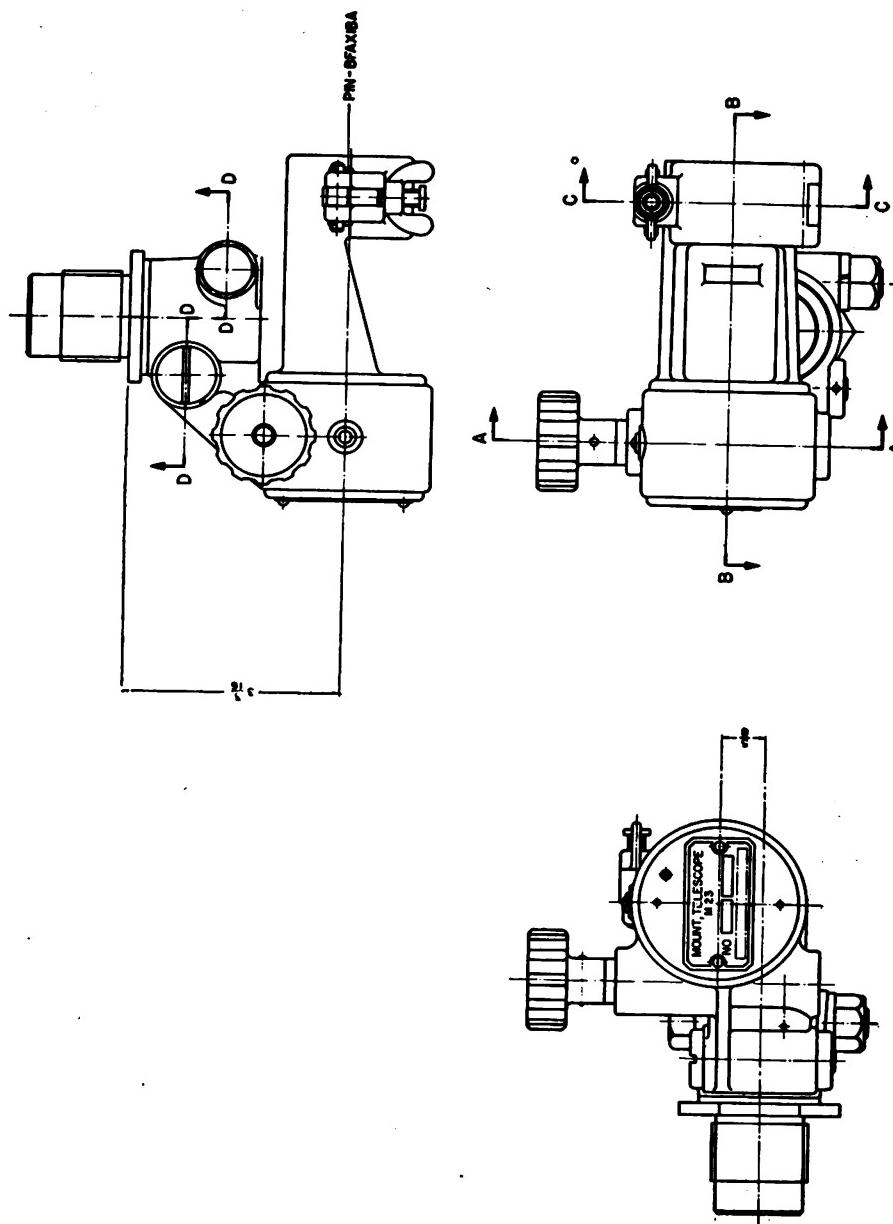


FIGURE 16.—Reticle pattern, panoramic telescope M5A3.



REF 90-72-2

FIGURE 17.—Telescope mount M23, assembled views.

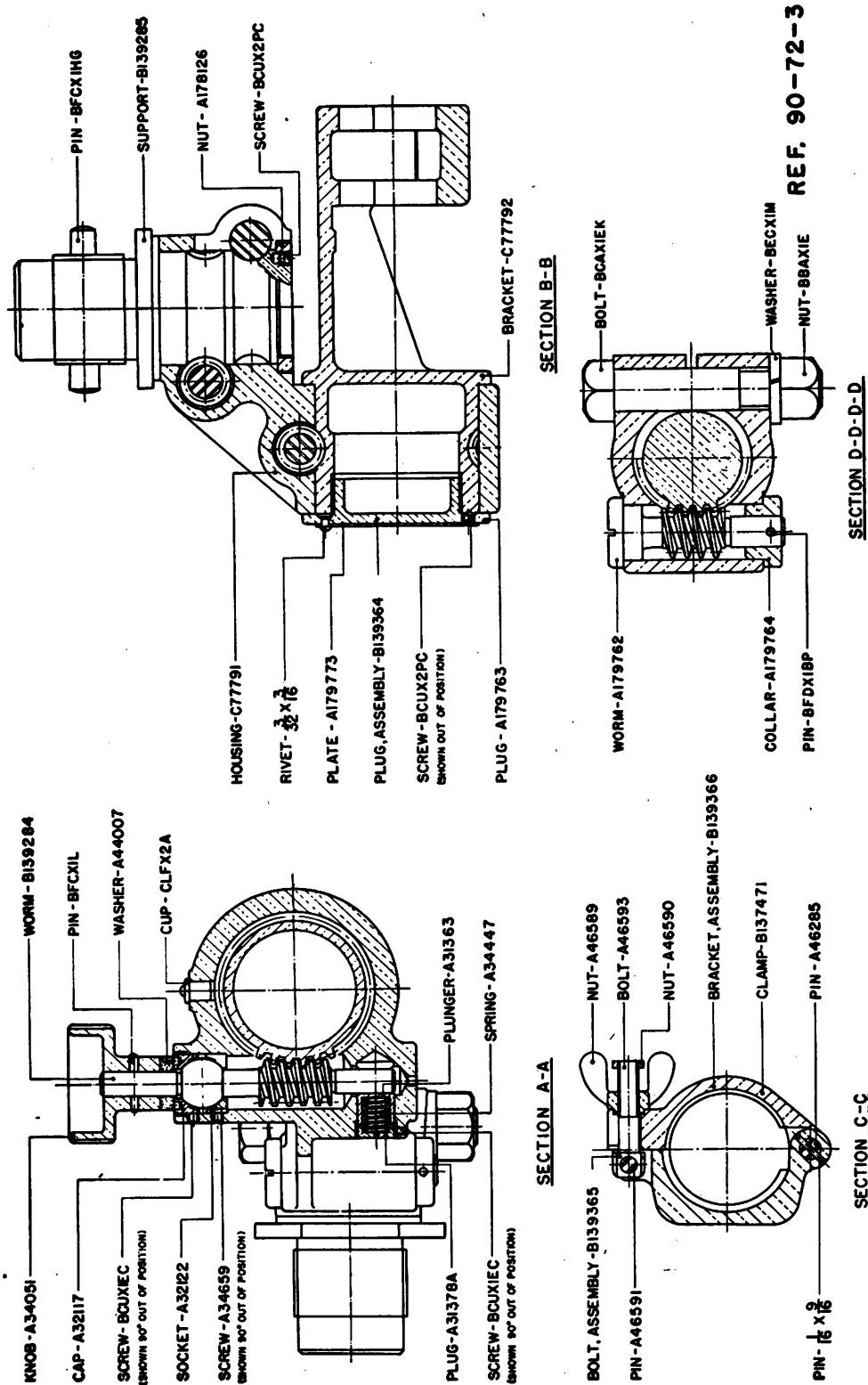
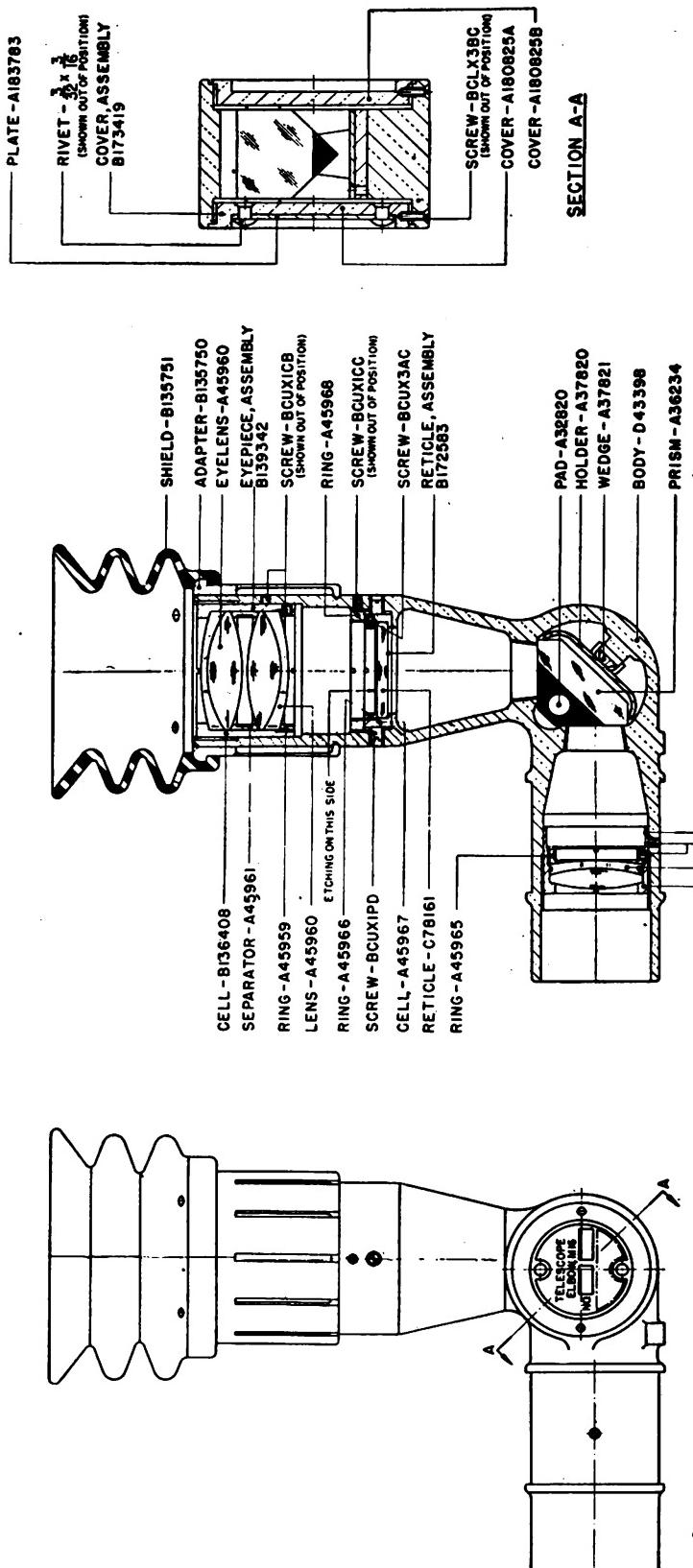


FIGURE 18.—Telescope mount M23, sectional views.



REF. 91-100-2

Power-----
E. F. L. of objective-----
E. F. L. of eyepiece-----

Diameter of exit pupil-----
Field of view-----
Apparent field of view-----

FIGURE 19.—Elbow telescope M16, assembled and sectional views.

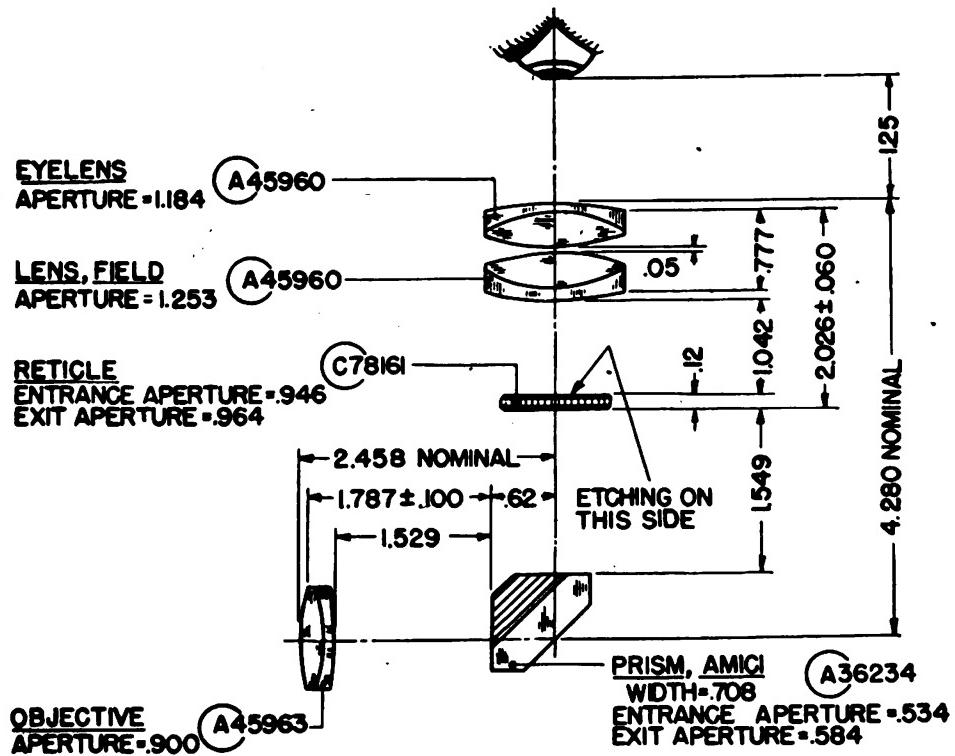
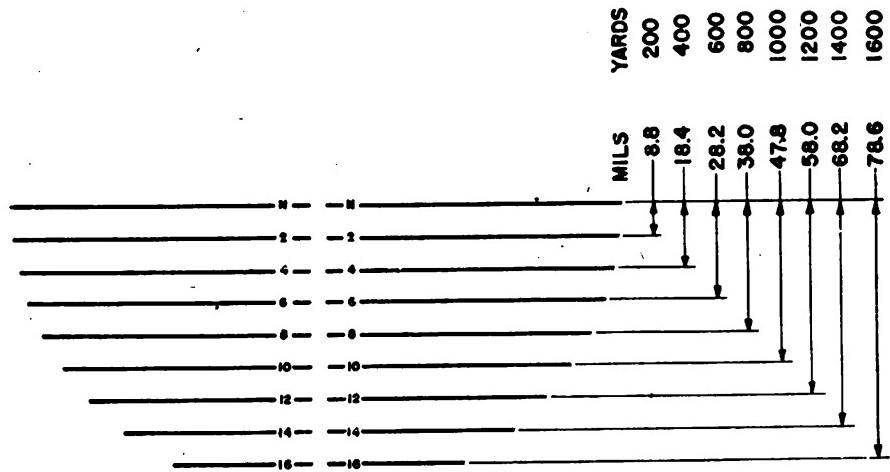


FIGURE 20.—Elbow telescope M16, optical system.



REF. 105-H-2V

FIGURE 21.—Reticle pattern, elbow telescope M16.

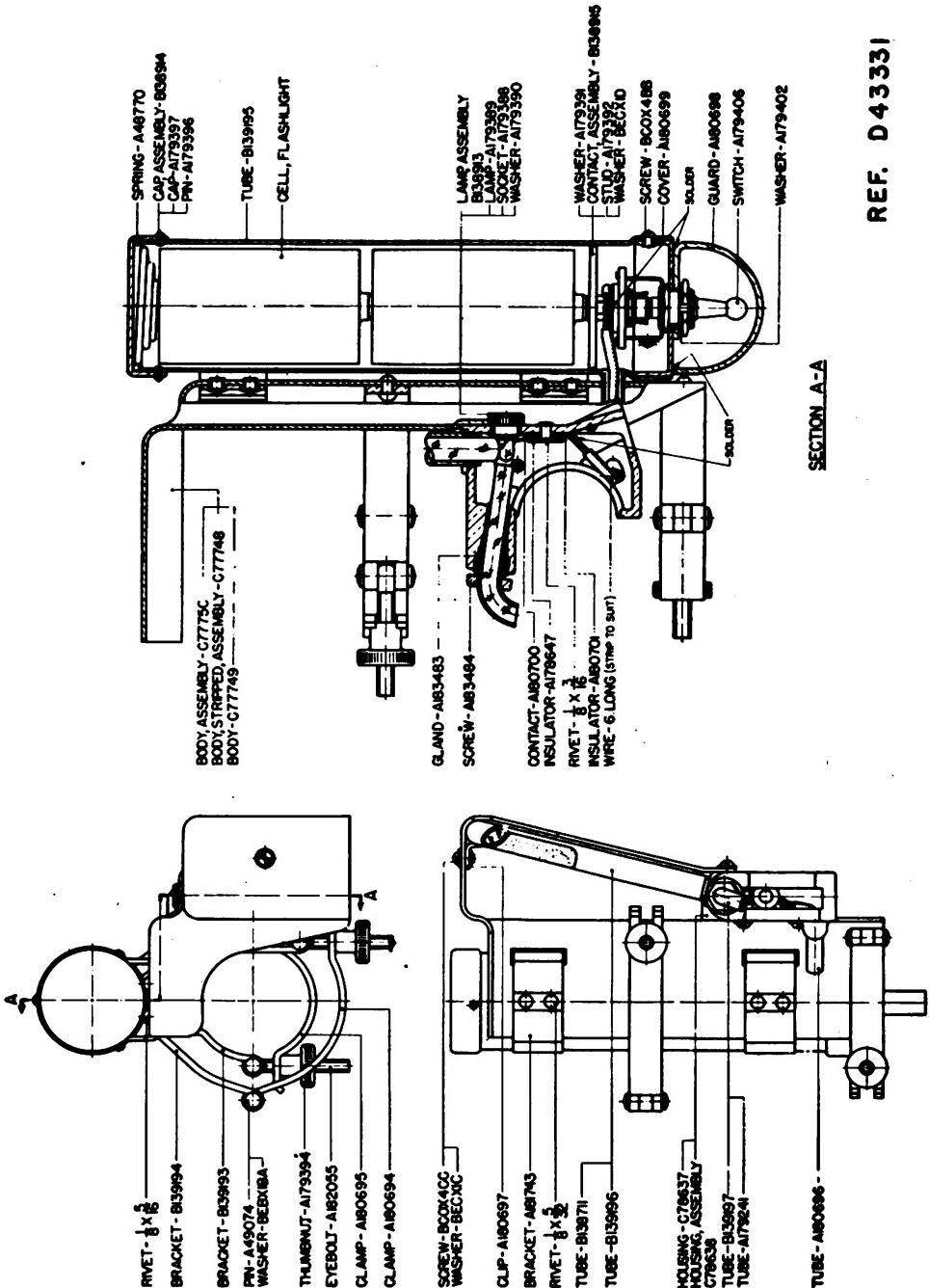


FIGURE 22.—Instrument light M5, assembled and sectional views.

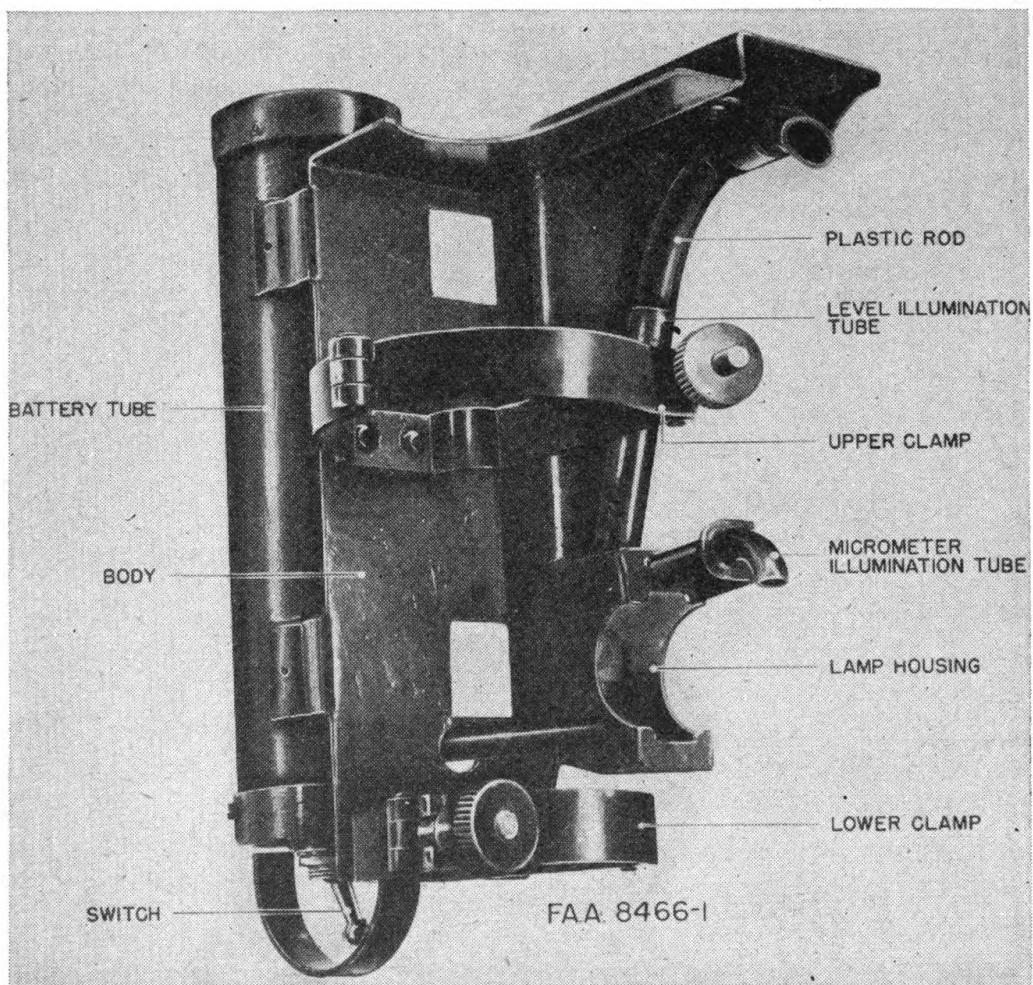


FIGURE 23.—Instrument light M5.

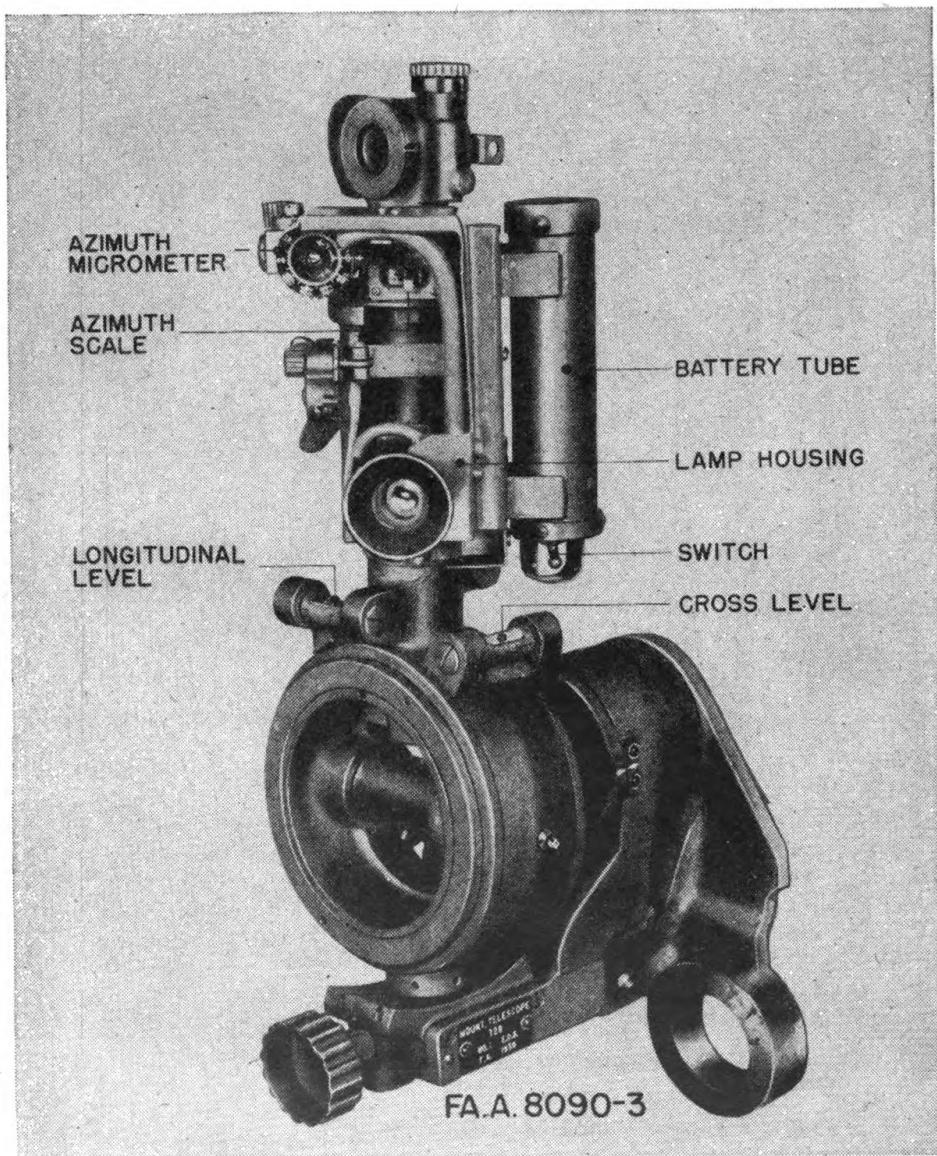


FIGURE 24.—Instrument light M5, mounted.

SECTION III

INSPECTION

	Paragraph
General-----	9
Telescope mount M21-----	10
Range quadrant M4-----	11
Elbow telescope M16-----	12
Telescope mount M23-----	13

9. General.—Inspection is for the purpose of determining the condition of the matériel, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. The following paragraphs will serve as a guide.

10. Telescope mount M21.

<i>Parts to be inspected</i>	<i>Points to be observed</i>
a. Exposed mechanical parts.	a. Examine telescope mount as a whole for loose and missing parts such as screws, knobs, etc.
b. Level vials.	b. See that longitudinal and cross level vials are not broken and that they are secure in their housings.
c. Longitudinal leveling.	c. Operate longitudinal leveling and cross leveling knobs to limit of their motion in each direction. Mechanisms should operate smoothly without undue friction or looseness.
d. Cross level and longitudinal level vial adjustment.	d. Set telescope mount so that axis of telescope socket is approximately vertical. Place test level on flat machined surface of telescope socket. Place level alternately longitudinally and transversely and operate associated controls of mount until level indication is obtained simultaneously in both directions. Then bubble in cross level vial and bubble in longitudinal level vial should be within one level vial graduation of central position. If this is not the case, an adjustment of level vials is necessary.

*Parts to be inspected***e. Instrument light.***Points to be observed*

e. Instrument light should furnish adequate illumination for instrument. Operate switch to see if it functions properly. Examine electrical connections and insulation on wires.

11. Range quadrant M4.*Parts to be inspected***a. Exposed mechanical parts.***Points to be observed*

a. Examine range quadrant for loose or missing parts and legibility of scales.

b. Elevating, cross level, and angle of site mechanisms.

b. Operate knobs of elevating, cross level, and angle of site mechanisms to limit of motion in each direction. Mechanisms should operate smoothly without undue friction or looseness.

c. Lighting equipment.

c. Observe whether or not lighting equipment functions properly. Range drum, elevation scale and associated micrometer, and angle of site scale and associated micrometer should be adequately illuminated. Examine connecting wires. If insulation is badly worn, replacement of wires is necessary.

d. Range drum and elevating worm micrometer adjustment.

d. Turn range drum knob until "0" indication is opposite its index. Then index of elevating worm micrometer should indicate 100 mils minus jump angle value. (For 1-mil jump angle, reading should be 99 mils.)

e. Alignment of elevation scale and angle of site level.

e. With lower surface of mount bracket (D43322, fig. 7) set horizontal, set elevation scale and associated micrometer to indicate zero by turning elevating knob (A179622, sec. A-A, fig. 7). Center angle of site level bubble by means of angle of site knob (A179627, fig. 6). Then angle of site index line should coincide with "3" graduation on angle of site scale and index of associated micrometer should coincide with zero.

Parts to be inspected

f. Backlash in elevating mechanism.

Points to be observed

f. Center bubble in angle of site level vial by turning elevating worm knob (A179614, fig. 7) in one direction. Record reading of indexes on elevation scale and associated micrometer. Then turn elevating worm knob approximately one turn farther in same direction, and center bubble again by turning knob in opposite direction. Again record readings of indexes on elevation scale and associated micrometer. The difference between initial and final readings is backlash. If backlash exceeds 0.5 mil, replacement or adjustment of wearing parts is necessary.

g. Backlash in angle of site mechanism.

g. Center bubble in angle of site level vial by turning angle of site micrometer knob (A179627, sec. F-F, fig. 6) in one direction. Record readings of indexes on angle of site scale and associated micrometer. Turn angle of site micrometer knob approximately a turn farther in same direction, and center bubble again by turning angle of site micrometer knob in opposite direction. Again record reading of indexes on angle of site scale and associated micrometer. The difference between initial and final readings is backlash. If backlash exceeds 0.5 mil, replacement or adjustment of wearing parts is necessary.

12. Elbow telescope M16.*Parts to be inspected*

Eyeshield.

Points to be observed

Examine rubber eyeshield for any cracks or breaks in rubber. If any of these are noticed, replacement is necessary.

13. Telescope mount M23.

Parts to be inspected

a. External mechanical parts.

b. Elevating worm mechanism.

c. Bracket rotating mechanism.

Points to be observed

a. Examine telescope mount as a whole for loose and missing parts.

b. Loosen clamping bolt (BCAX-1EK, sec. D-D-D-D, fig. 18). By means of a screw driver rotate elevation adjusting worm (A179762) and observe whether or not it functions properly.

c. Turn bracket rotating worm knob (A34051, sec. A-A, fig. 18) several turns in each direction. Observe whether or not operation is smooth without undue friction or looseness.

SECTION IV

MAINTENANCE AND REPAIR

	Paragraph
Tools	14
Verification of adjustments	15
Adjustment of telescope mount M21 and panoramic telescope M5A3	16
Adjustment of range quadrant M4	17
Disassembly and assembly	18
Disassembly of telescope mount M21 cross leveling mechanism	19
Disassembly of telescope mount longitudinal leveling worm	20
Replacement of longitudinal level vial	21
Disassembly of range quadrant elevating mechanism	22
Disassembly of range quadrant cross level mechanism	23
Disassembly of range quadrant angle of site mechanism	24
Replacement of electric lamp	25
Replacement of cross level and longitudinal level vials	26
Replacement of elbow telescope eyeshield	27
Disassembly of bracket rotating worm	28
Disassembly of telescope mount elevation adjusting worm	29
Reassembly	30
Lubrication when assembling	31

14. Tools.—An optical repair kit containing the necessary tools, fixtures, cements, oils, etc., for use with this equipment is furnished to ordnance maintenance companies. A complete list of the items comprising the kit is contained in a blueprint which is fastened to the cover of the chest. Every item in the kit is designated by a number equivalent to the compartment number. Most of the items such as screw drivers, etc., require no description, as their uses are

self-explanatory. The collimating telescope (C49108) which is furnished with the kit is an ordinary nonerecting type. It is adjusted for parallax by focusing the eyepiece on the cross wires and then removing parallax by focusing the objective, temporarily loosening the drawtube clamping screw in the side of the telescope for the purpose.

15. Verification of adjustments.—Many of the adjustments on this equipment can be verified by following the procedure given in section III. Other adjustments can be verified by following the procedure given with the specific adjustment.

16. Adjustment of telescope mount M21 and panoramic telescope M5A3.—*a. Telescope mount cross level segment* (B136511, sec. A-A, fig. 2).—Any play that develops between the cross level segment and the associated bushing in the telescope mount body (D29385, sec. D-D, fig. 4) should be taken up by loosening the locking screw (BCUX1FE) and tightening the retaining nut (A36496) until all play is removed. Then tighten the locking screw. The adjustment should not be so tight as to cause binding of the parts.

b. Cross level vial (A31314, sec. E-E, fig. 3).—Since the adjusting procedures for the longitudinal level vial and the cross level vial are similar, only the procedure for adjusting the latter is given. Remove the plug (A34057) and associated pin (BFDX3.1D) from the left side of the level vial tube. This permits access to the four level vial adjusting screws (BCUX2CB). Arrangement of these screws is such that a small lateral as well as vertical adjustment is permitted. When adjusting, as one screw is screwed in the opposite one should be backed out. Replace plug and pin after the adjustment is completed.

c. Lateral and vertical adjustments of telescope.—Level the gun and gun carriage horizontally and place the test target in position by bore sighting.

(1) *Lateral adjustments.*—(a) Set the micrometer knob (fig. 26) to "0" against the fixed index and rotate the azimuth setting knob until the "0" on the azimuth scale coincides with its index. If the micrometer index does not read zero, loosen the screw in the end of the micrometer index and set the index arrow to zero, then tighten the locking screw.

(b) Loosen the locking screws (16, fig. 25) and adjust the tangent screws (17) until the vertical cross line on the reticle falls on the vertical cross line on the test target. Tighten the locking screw. The tangent screws must be set snugly against the upper lug (see fig. 26) on the telescope but not tight enough to lock it in the socket.

(2) *Vertical adjustment.*—Turn the elevation knob on the telescope until the horizontal cross line on the reticle falls on the horizontal cross line on the test target. Loosen the screws in the end of the knob and, holding the knob, slip the elevation micrometer until the "0" graduation lines up with its index. Tighten the screws, being careful not to disturb the setting.

17. **Adjustment of range quadrant M4.**—*a. Range drum* (sec. A-A, fig. 7).—Loosen the three elevating knob screws. With one hand rotate the range drum knob (A179622) until the "0" indication is opposite its index. Holding the knob stationary in this position, rotate the elevating worm micrometer (A178601) until the indication 100 mils minus the jump angle value is opposite the index. Then tighten the three elevating knob screws.

b. Cross level gear segment (B139108, sec. G-G, fig. 6).—Any play which develops between the cross level gear segment and the associated bushing should be taken up by loosening the locking screw (BCUX1FE) and tightening the retaining nut (A36496). Tighten the locking screw after the adjustment is completed. The adjustment should not be so tight as to cause binding of the parts.

c. Angle of site level vial (A31314, sec. C-C, fig. 7).—Since the adjusting procedure for the cross level vial is similar to that of the angle of site level vial, the procedure for the latter only is given. Remove the right level vial plug (A34057) after removing the associated pin, $\frac{1}{16} \times \frac{13}{16}$. Access can now be had to the four adjusting screws (BCUX2CB). When adjusting, as one screw is screwed in the opposite one should be backed out. After the adjustment, replace the plug and pin.

d. Angle of site micrometer (A179625, sec. F-F, fig. 6).—Loosen the cap nut (A179628). With one hand hold the angle of site knob stationary and with the other rotate the angle of site micrometer (A179625) until the desired indication is opposite the index. Then tighten the cap nut.

e. Elevation scale index (A179610) *and angle of site scale* (A179613).—These parts have slotted holes and are attached by means of screws. Adjustment is accomplished by temporarily loosening the screws and shifting the part the proper amount.

f. To remove backlash.—(1) To remove backlash from the elevating mechanism take hold of the elevating worm knob and test for lateral and longitudinal play. If there is lateral play, remove the plug (A36245, fig. 7) and check the functioning of the spring and plunger (A46246 and A46245). If there is longitudinal play remove the range drum, back off the range drum adapter (A179634)

and washer (A179637) and with a spanner wrench tighten the ball cap (A34054, sec. B-B, fig. 7) just sufficiently to eliminate the play. If the backlash is still excessive, replace worn worm and/or gear.

(2) To remove backlash from the angle of site mechanism, first check the plunger spring (A34447, fig. 6); tighten the plug (A34656) as tightly as possible without causing the mechanism to bind. To adjust for longitudinal play, tighten the ball cap (A32117) with a spanner wrench. If there is still excess backlash in the mechanism replace the worn worm and/or gear.

18. Disassembly and assembly.—The assembled and sectioned views and schematic drawings show the location of the various parts and the means by which they are held in place. These figures should be carefully studied before attempting any assembling or disassembling operation.

19. Disassembly of telescope mount M21 cross leveling mechanism.—*a.* Loosen the locking screw and cross level segment retaining nut (1, fig. 28). Remove the four flathead screws (2) from the cross level housing (3) and carefully drive out the pin (4).

b. Loosen the locking screw (5) and remove the actuating arm nut (6). Grasp the cross leveling worm knob with one hand and with the other hand grasp the telescope mount body and extract the actuating arm with its associated parts from the telescope mount bracket (7).

c. Rotate the cross leveling knob (8) until the motion is prevented by the left cross level segment stop. The segment is now in the position shown in figure 28E. Remove the right cross level gear segment stop by removing the screw that holds it to the segment (9). Rotate the cross level knob until the cross level worm is unmeshed. Slide the cross leveling segment from its housing (fig. 28F).

d. Remove the nut (10), washer (11), cross level knob (8), and felt washer (12) as shown in figure 28G.

e. Loosen the locking screw (13) and unscrew the ball (14). Loosen the locking screw (15) and remove the plunger plug (16), plunger spring (17), and plunger (18).

f. To complete the disassembly of the cross leveling mechanism, loosen the locking screw (19) and remove the cross level worm gear (21) together with the ball socket (20) from the cross level housing (3).

g. Access for further disassembly of the mechanism can now be had if necessary.

h. Before reassembling, loosen the locking screws (1, fig. 29) and the gib adjusting screws (2). Lubricate the cross level segment

felt washer with oil and place a thin film of grease on the worm gear. (See sec. V for lubrication instructions.)

20. Disassembly of telescope mount longitudinal leveling worm (fig. 30).—Remove the knob nut (1) with washer (2) and extract the longitudinal worm knob (3). Slide the felt washer (4) from the worm shaft. Loosen the locking screw (5) and remove the ball cap (6). Loosen the locking screw (7) and remove the plunger plug (8), spring (9), and plunger (10). Loosen the locking screw (11) and extract the longitudinal worm (12) with the ball socket (13) from the telescope mount bracket (14), after disengaging the worm from the gear segment.

21. Replacement of longitudinal level vial (A31314, Sec. E-E, fig. 3).—*a.* Remove the pin (BFDX3.1D) and the tube plug (A34057) from each end of the longitudinal level tube. Loosen the four adusting screws (BCUX2CB). Extract the pin (BFDX1AB) and remove the level tube from the housing.

b. Clean out the broken parts of the level vial and the old calcined gypsum setting. Carefully locate the level vial in the level tube so that the graduations are centered in the tube opening. Pack with calcined gypsum (plaster of paris). Tighten the adjusting screws and replace the plugs and pins.

22. Disassembly of range quadrant elevating mechanism.—
a. Remove the elevating micrometer knob (A179614, sec. A-A, fig. 7) after removing the three machine screws (BCGX3FG). Slide off the elevating worm micrometer (A178601). Drive out the pin (BFCX1BD) and remove the micrometer adapter (A178602).

b. Unscrew the elevating worm plug (A36245) after loosening the locking screw (BCUX1FD). Remove the plunger spring (A46246) and plunger (A46245).

c. Unscrew the wing nut (A179636, sec. A-A, fig. 7) and remove the range drum knob (A179622). Rotate the range drum and pull out on it so that the range drum pointer (A178613) becomes disengaged from the drum. Then carefully remove the drum from the range quadrant.

d. Carefully drive out the range drum adapter pin (BFCX1BC) and slide the associated adapter (A179634, sec. A-A, fig. 7) about an inch to the right. Move the felt washer (A179637) also to the right. Loosen the headless locking screw (BCUX1FE) and the special headless screw (A179601). Unscrew the ball cap (A34054) and carefully unthread the elevating worm from the elevating gear (C77685, fig. 6). Then remove the elevating worm from the elevating gear housing.

e. When reassembling, the worm shaft felt washer (A179637, fig. 7) should be oiled sparingly. Care should be exercised to see that the range drum pointer properly fits into its groove on the range drum before the range drum knob (A179622) and associated wing nut (A179636) are assembled.

23. Disassembly of range quadrant cross level mechanism.—

a. Loosen the cross level gear segment retaining nut (A36496, sec. D-D, fig. 6) after loosening the locking screw (BCUX1FE). Remove the four flathead screws (BCLX3FG, sec. G-G) from the quadrant mount bracket (D43322, sec. A-A, fig. 7). Carefully drive the pin (BFCX1DE, sec. D-D, fig. 6) from the cross level housing (677690).

b. Remove the nut (A179488, sec. A-A, fig. 7) from the quadrant body shaft (A179624, sec. D-D, fig. 6) after driving out the associated pin (BFAX1DK, sec. A-A, fig. 7). Remove the battery bracket cover plate (A178634 (not designated)) by removing the associated screw (A44518, fig. 5). Disconnect the wires at the toggle switch. Grasp the quadrant mount housing (C77684, sec. D-D, fig. 6) and remove it from the range quadrant bracket (D43322, sec. A-A, fig. 7). Care should be exercised that the wires from the lighting equipment are not damaged during this procedure.

c. Rotate the cross level worm knob, so that access can be had to either of the gear segment stops (A34159, sec. D-D, fig. 6). Remove the gear segment stop by removing the flathead screw (BCLX3FE). Unmesh the cross level worm by rotating the associated knob, and remove the cross level worm housing (C77690).

d. Access can now be had for further disassembly of the cross level worm gear and associated parts if necessary.

e. Before reassembling, loosen the locking screws (BCUX1ED, fig. 6) and gib screws (BCUX1FH).

f. When reassembling, the felt washers of the cross level worm gear and of the cross level gear segment should be sparingly lubricated with oil.

24. Disassembly of range quadrant angle of site mechanism (sec. F-F, fig. 6).—a. Remove the angle of site worm plug (A34656) after loosening the locking screw (BCUX1EC). Remove the worm plunger spring (A34447) and associated plunger (A34709).

b. Remove the angle of site knob (A179627) after removing the associated nut (A179628). Remove the angle of site micrometer (A179625). Extract the micrometer adapter (A179609) from the worm shaft after driving out the associated pin (BFCX1M). Slide off the felt washer (A179629).

c. Loosen the headless screw (BCUX1EC) and the special screw (A34659). Unscrew the ball cap (A32117). Unthread the angle of site worm (A177756) and remove it together with the ball socket (A32122) from the angle of site housing (C77692).

d. Remove the level vial light socket (A179388, sec. E-E, fig. 6). Remove the lamp and disconnect the lighting wires from the socket. Remove the level housing assembly (C77686, sec. D-D, fig. 6) after removing the four screws (BCGX3EG) and washers (BECX2D).

e. Remove the lead wire retainer (B139110) after removing the four associated screws (BCLX3EF). Care should be exercised that the lighting wires are not injured during this procedure. Slide off the angle of site worm housing (C77692, sec. F-F).

f. When reassembling, lubricate the angle of site worm felt washer (A179629) with a few drops of oil.

25. Replacement of electric lamp (A179389, sec. E-E, fig. 6).—Unscrew the socket (A179388) and remove the lamp from the socket. Screw a new lamp in the socket and replace the socket in the adapter.

26. Replacement of cross level and longitudinal level vials (sec. C-C, fig. 7).—Since the procedure is similar for both level vials only the procedure for the cross level vial will be given.

a. Remove the level vial plug (A34057) after extracting the associated pin. Remove the vial tube pin (BFDX1AB). Loosen each of the four level vial adjusting screws (BCUX2CB) and extract the level vial tube from the housing.

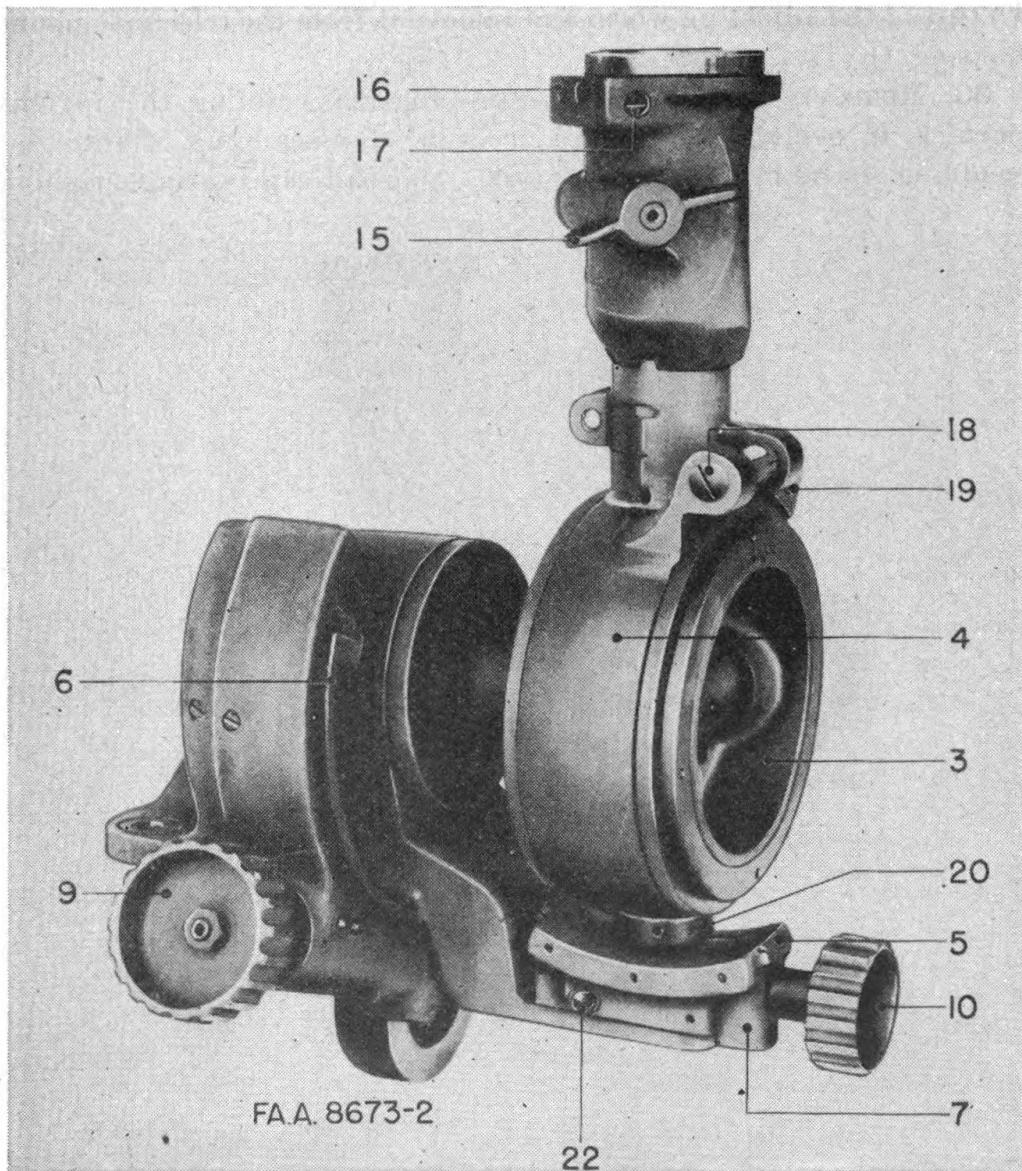
b. Clean out the broken parts of the level vial and the old plaster setting. Place a new level vial in the level tube and locate it in the level tube so that the graduations are centered in the tube opening. Pack with calcined gypsum (plaster of paris).

c. The end of the level vial next to the electric lamp should be clean and free from dust, to permit proper illumination of the level vial. The level vial adjusting screws should be tight to hold the vial firmly in place before the other parts are replaced.

27. Replacement of elbow telescope eyeshield (B135751, fig. 19).—Grasp the eyeshield, twist it slightly, and pull it free from the telescope adapter (B135750). When replacing the eyeshield, the telescope adapter should be properly fitted into the groove of the eyeshield.

28. Disassembly of bracket rotating worm (B139284, sec. A-A, fig. 18).—a. Unscrew the worm plug (A31378A) by first loosening the headless screw (BCUX1EC). Extract the plunger spring (A34447) and plunger (A31363).

b. Remove the worm knob (A34051) after driving out the pin (BFCX1L). Remove the felt washer (A44007). Unscrew the ball cap (A32117) after loosening the headless locking screw (BCUX-1EC). Loosen the headless special screw (A34659), unthread the bracket rotating worm (B139284), and remove it together with the



- | | |
|---------------------------------|------------------------------|
| 3. Bearing. | 15. Wing knob. |
| 4. Body. | 16. Lock screw. |
| 5. Cross leveling gear segment. | 17. Tangent screw. |
| 6. Rocker. | 18. Longitudinal level plug. |
| 7. Cross leveling worm housing. | 19. Cross level plug. |
| 9. Longitudinal leveling knob. | 20. Nut. |
| 10. Cross leveling knob. | 22. Oil fitting. |

FIGURE 25.—Telescope mount M21.

ball socket (A32122) from the telescope mount housing (C77791, sec. B-B).

29. Disassembly of telescope mount elevation adjusting worm (A179762, sec. D-D-D-D, fig. 18).—Loosen the telescope mount housing clamp bolt (BCAX1EK). Remove the worm collar (A179764) by first driving out the associated pin (BFDX1BP). Unthread the adjusting worm and remove it from the telescope mount housing (C77791, sec. B-B).

30. Reassembly.—The procedure for reassembling the various parts is in general the reverse order of disassembling. When assembling shafts fitted with ball socket and ball cap bearings, tighten

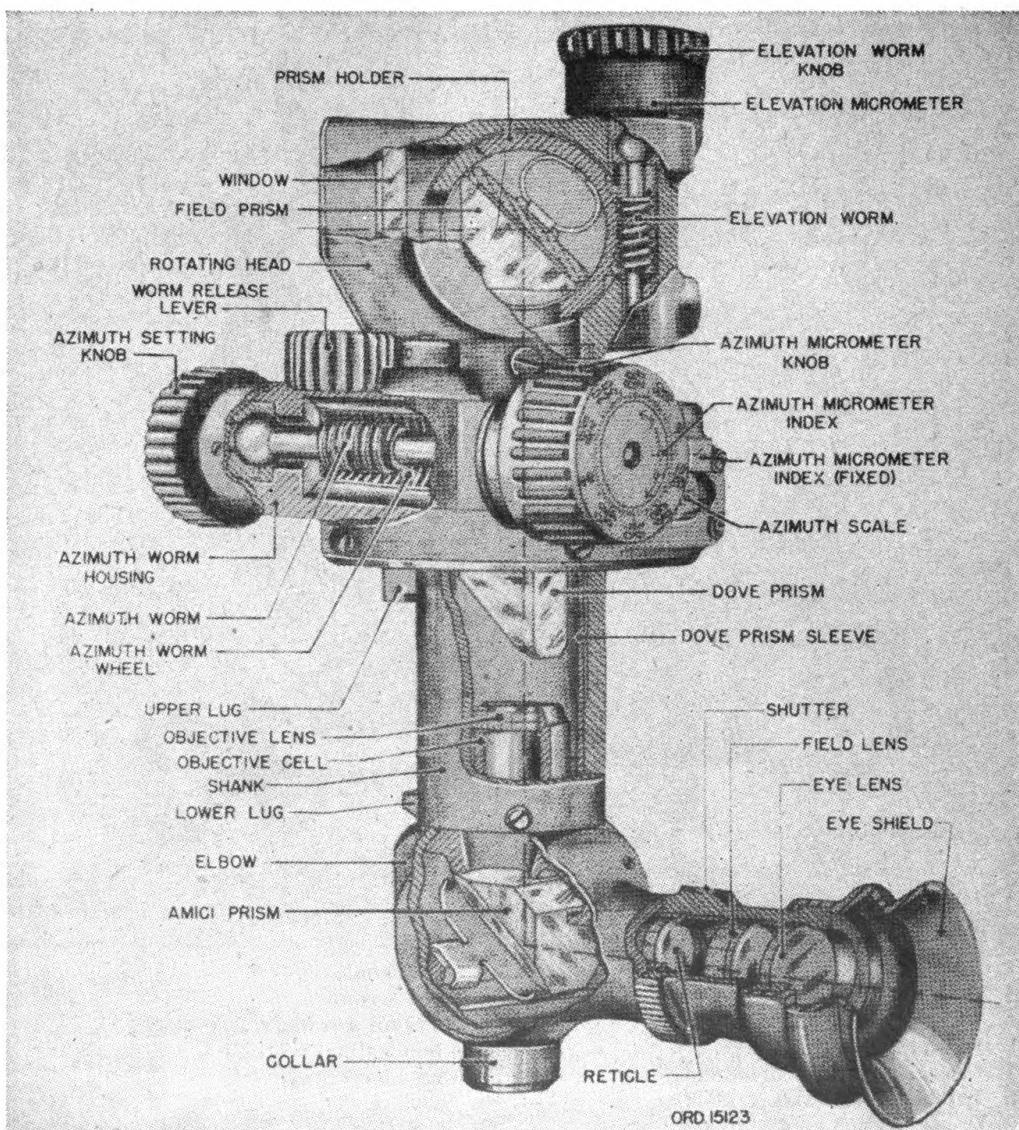


FIGURE 26.—Panoramic telescope M5A3, cutaway sections.

the cap to a snug fit on ball enough to take up lost motion but not so tight as to cause binding.

31. Lubrication when assembling.—Before assembling, clean all parts with dry-cleaning solvent, and apply a light film of grease, special, low temperature.

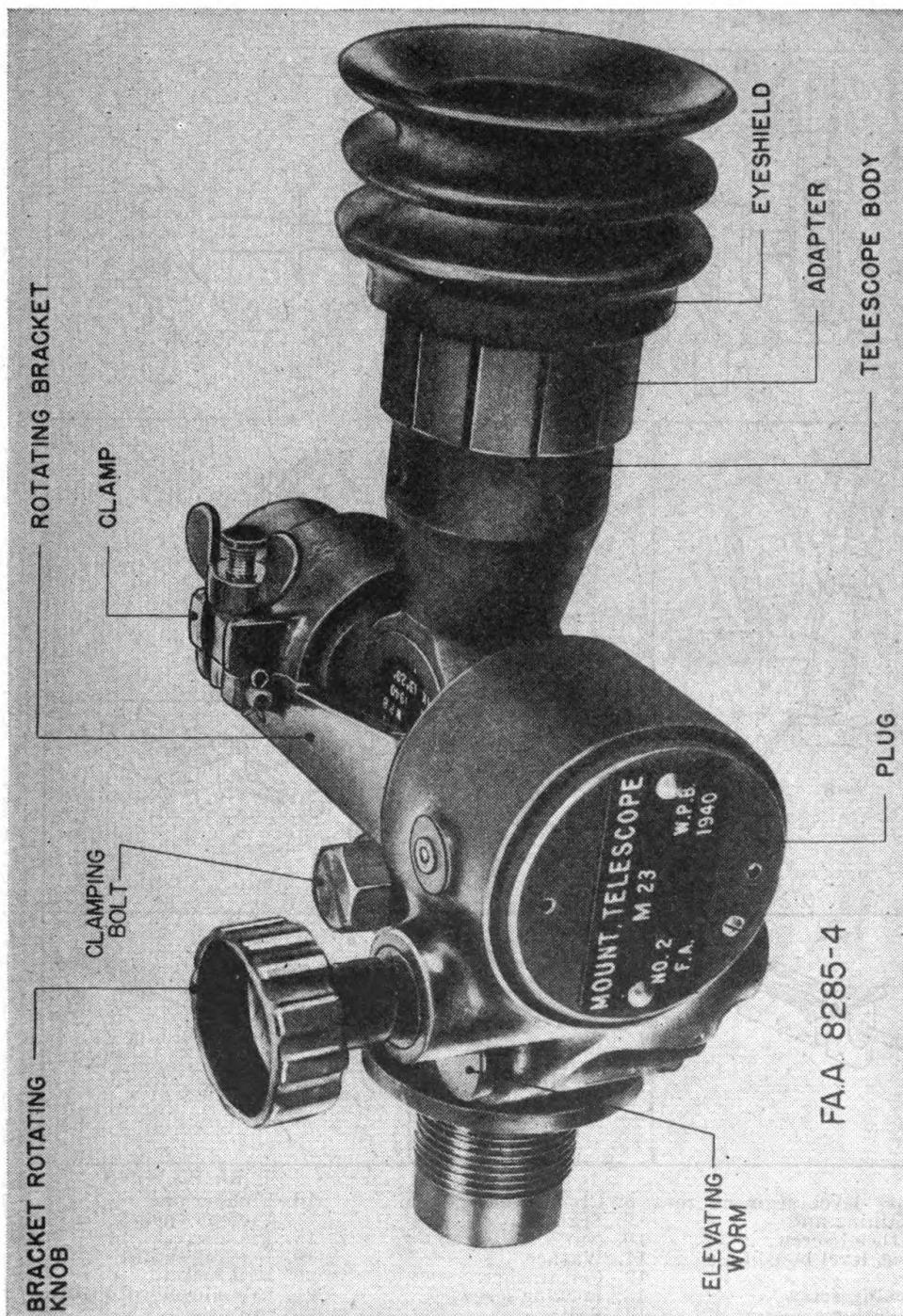
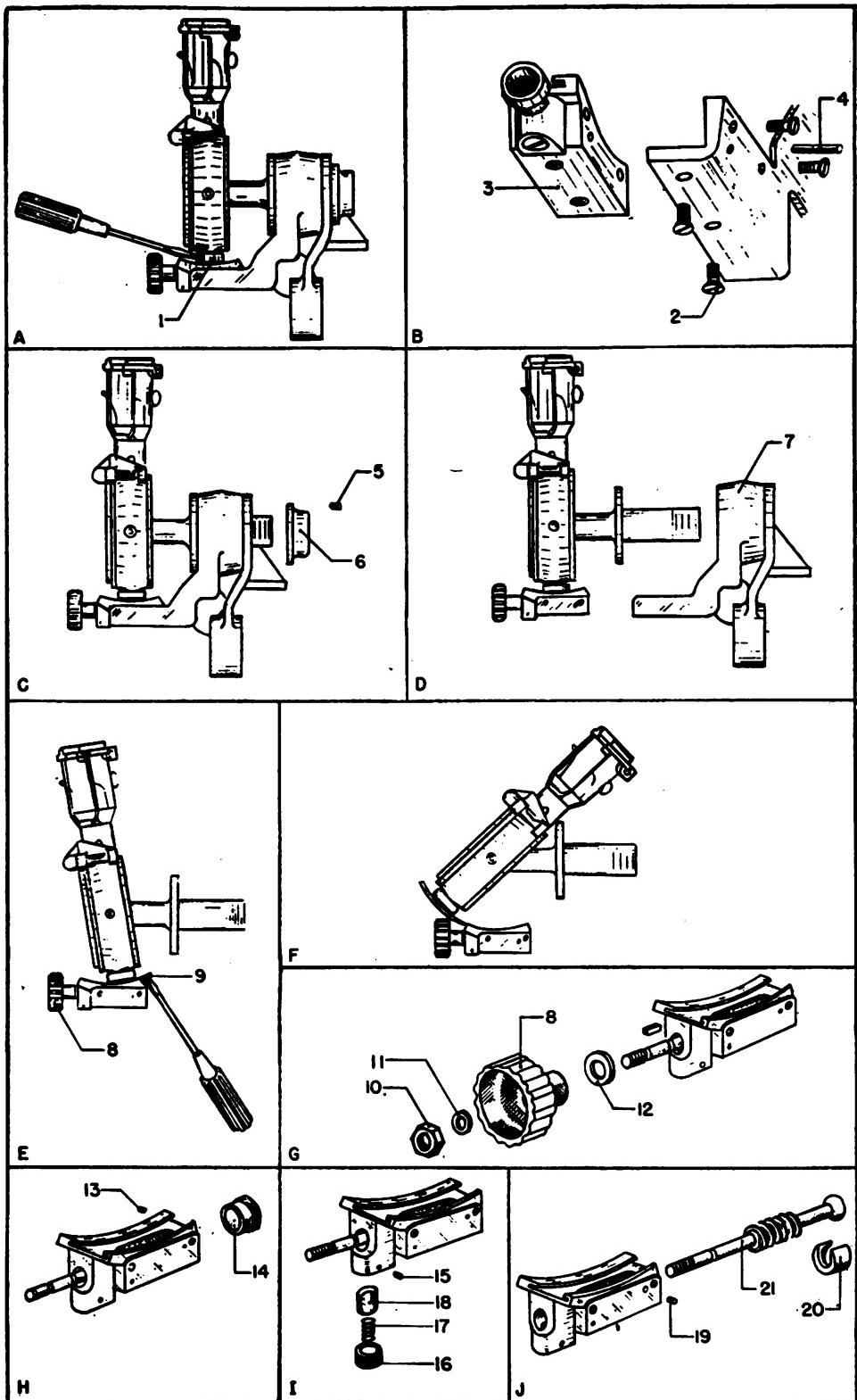


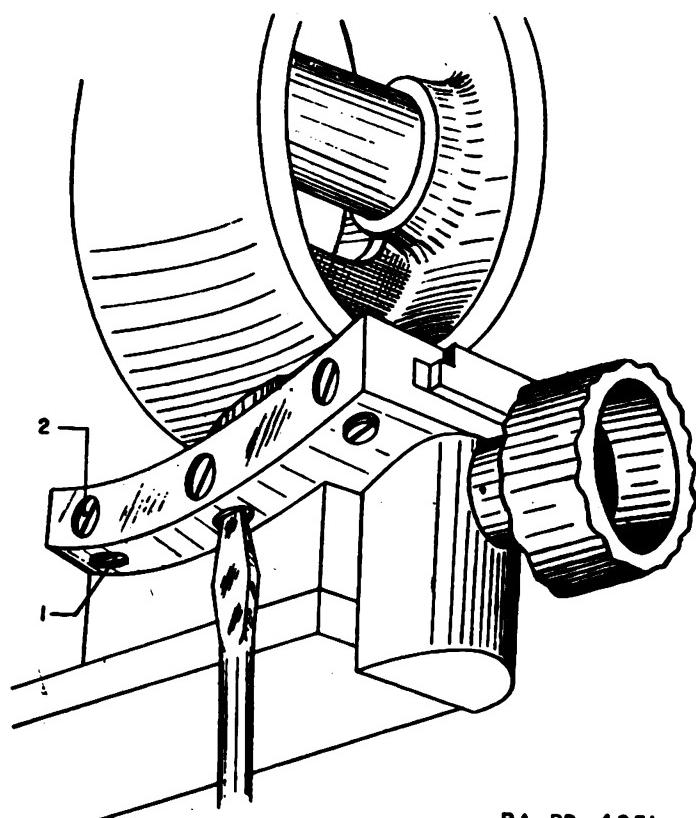
FIGURE 27.—Telescope mount M23 and elbow telescope M16.



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|---------------------------------------|-------------------------|----------------------------|
| 1. Cross level segment retaining nut. | 8. Cross leveling knob. | 16. Plunger plug. |
| 2. Flathead screw. | 9. Segment. | 17. Plunger spring. |
| 3. Cross level housing. | 10. Nut. | 18. Plunger. |
| 4. Pin. | 11. Washer. | 19. Locking screw. |
| 5. Locking screw. | 12. Felt washer. | 20. Ball socket. |
| 6. Actuating arm nut. | 13. Locking screw. | 21. Cross level worm gear. |
| 7. Telescope mount bracket. | 14. Ball. | |
| | 15. Locking screw. | |

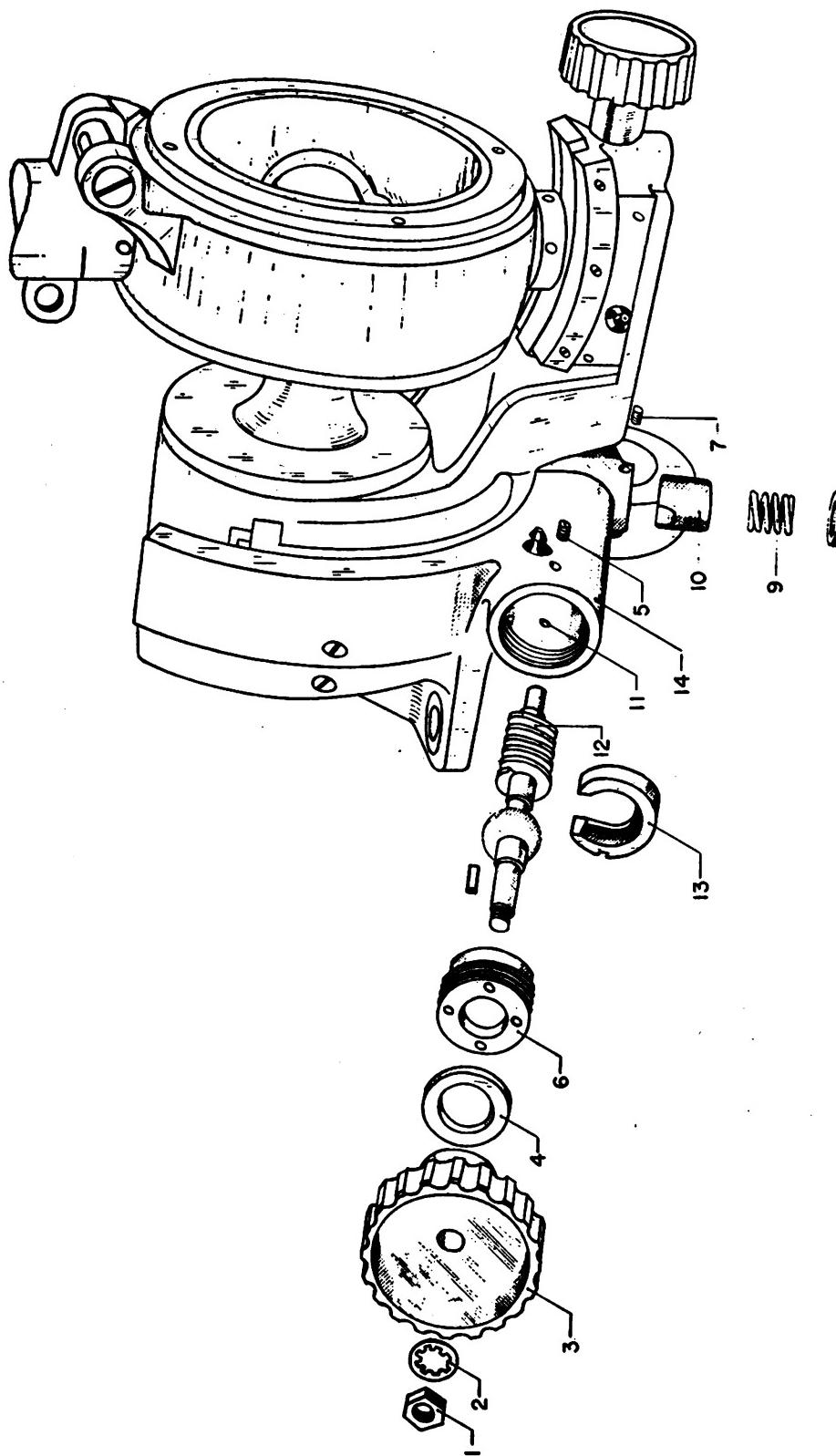
FIGURE 28.—Disassembly of telescope mount M21 cross leveling mechanism.



RA PD 4251

1. Locking screw.
2. Gib adjusting screw.

FIGURE 29.—Gib adjustment for reassembly.



RA PD 4249

1. Knob nut. 3. Worm nut. 5. Locking screw. 7. Locking screw. 9. Plunger spring. 11. Locking screw. 13. Ball socket.
2. Washer. 4. Felt washer. 6. Ball cap. 8. Plunger plug. 10. Plunger. 12. Longitudinal worm. 14. Telescope mount bracket.

FIGURE 30.—Disassembly of telescope mount M21 longitudinal leveling mechanism.

SECTION V

CARE AND PRESERVATION

	Paragraph
Telescope mounts M21 and M23 and range quadrant M4-----	32
Panoramic telescope M5A3 and elbow telescope M16-----	33
Instrument light M5-----	34

32. Telescope mounts M21 and M23 and range quadrant M4.—*a. Handling and operating precautions.*—(1) Care should be exercised to avoid rough handling which might disturb the adjustment of the level vials.

(2) Keep the level vials covered at all times when not in use.

(3) Stops are provided to limit the motion of the worm mechanisms. No attempt should be made to force the mechanisms beyond these limits.

(4) No attempt should be made to rotate the elevating worm (fig. 27) on the telescope mount M23 without first loosening the clamping bolt.

b. Lubrication.—(1) Lubricate the telescope mounts M21 and M23 and range quadrant M4 on assembly with the following lubricants furnished by the Ordnance Department:

Grease, special, low temperature.

Oil, lubricating, for aircraft instruments and machine guns.

(2) Lubricate gears, ball bearings, and all other sliding surfaces with a thin film of grease. Coat the locating surfaces and the retaining shaft in the telescope socket lightly with oil to prevent rusting. Lubrication fittings on the telescope mount M21 will not be used as a means of lubricating the matériel. However, these fittings will not be removed, as developments in the future may necessitate their use.

(3) Lubricate the felt washers located on the various worm shafts of the telescope mount and range quadrant sparingly with a few drops of oil.

(4) Lubricate bracket rotating worm (B139284, sec. A-A, fig. 18) and bracket trunnion on the telescope mount M23 occasionally by applying a few drops of oil through the oil cup in the housing.

(5) Keep the exterior surfaces of the telescope mounts and the range quadrant free of dirt and excess lubricants.

(6) Lubricants for fire control instruments function also as rust preventives. It is important that they be applied carefully. Too much grease applied to delicate movements may cause stiffness of operation in cold weather.

33. Panoramic telescope M5A3 and elbow telescope M16.—*a. Handling and operating precautions.*—(1) The panoramic tele-

scope M5A3 and elbow telescope M16 are precision optical instruments and the utmost care should be exercised in handling them to prevent damaging or disturbing the optical systems and related mechanisms.

(2) The worm release lever (fig. 26) on the panoramic telescope should be operated carefully to avoid damage to the worm threads and worm gear teeth when reengaging.

(3) Wipe all dust and grit from the contact and locating surfaces on the telescopes before assembling to the mounts.

(4) Care should be exercised to prevent denting the lugs (fig. 26) and collar of the panoramic telescope and the locating surfaces in the socket when assembling the telescope to the mount.

(5) When not in use, place the telescopes in the carrying cases provided for them.

(6) Avoid bringing oil or grease into contact with the optical parts.

b. Lenses.—(1) Do not touch or attempt to wipe lenses or windows with the fingers or an oily cloth. Remove dust and grit from optical surfaces with a camel's-hair brush or lens tissue.

(2) To remove oil or grease from optical surfaces, apply alcohol sparingly with a camel's-hair brush and wipe off gently with lens tissue. If alcohol is not available, breathe heavily on the lens to moisten it and wipe dry as directed above. Repeat the operation until the surface is clean.

c. Lubrication.—(1) The lugs (fig. 26) and collar of the panoramic telescope should be lightly coated with oil to prevent rusting.

(2) The internal mechanism of the panoramic telescope is lubricated at assembly by the manufacturer and therefore should require lubrication only at very long intervals and then by trained personnel.

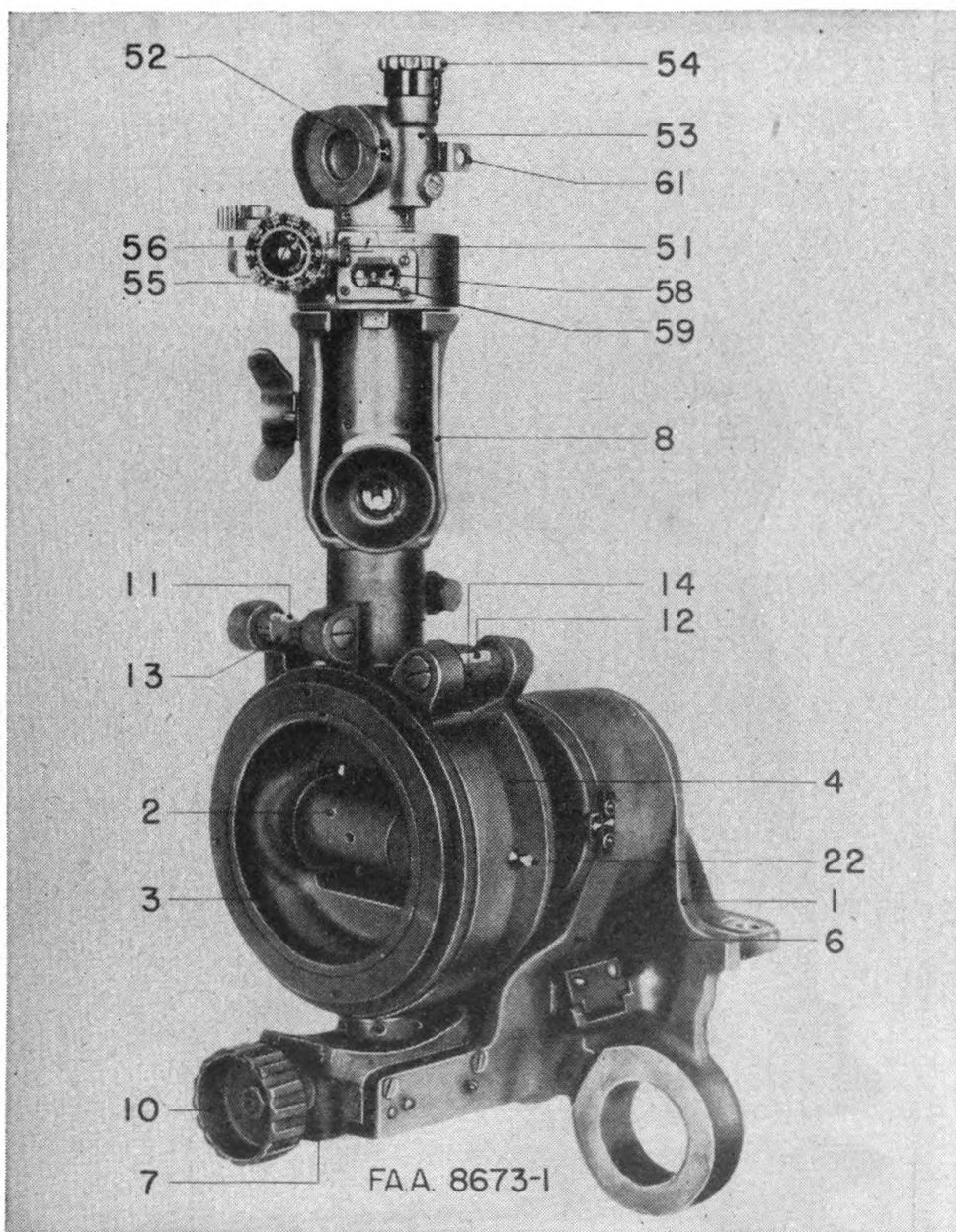
34. Instrument light M5.—*a.* Care must be exercised to prevent bending the body or brackets of the instrument light.

b. Remove the cells from the battery tube (fig. 23) whenever the instrument is not in use; otherwise the chemical reaction set up in them will damage the tube.

c. Keep the clamp screws tight. If they are allowed to work loose, the resulting vibration will damage the lamp.

d. When assembling the instrument light to the mount, slide the upper clamp between the socket and wing knob. No attempt should be made to lift the clamp over the wing knob on the socket after the instrument light is in place.

e. When not in use, place the instrument light in the packing chest provided for that purpose.



- | | |
|---------------------------------|---------------------------------------|
| 1. Bracket. | 14. Cross level cover. |
| 2. Actuating arm. | 22. Oil fitting. |
| 3. Bearing. | 51. Azimuth micrometer index (fixed). |
| 4. Body. | 52. Elevation index. |
| 6. Rocker. | 53. Rotating head. |
| 7. Cross leveling worm housing. | 54. Elevation knob. |
| 8. Telescope socket. | 55. Azimuth micrometer knob. |
| 10. Cross leveling knob. | 56. Azimuth micrometer index. |
| 11. Longitudinal level. | 58. Azimuth scale. |
| 12. Cross level. | 59. Azimuth scale index. |
| 13. Longitudinal level cover. | 61. Open sight. |

FIGURE 31.—Telescope mount M21 and panoramic telescope M5A3.

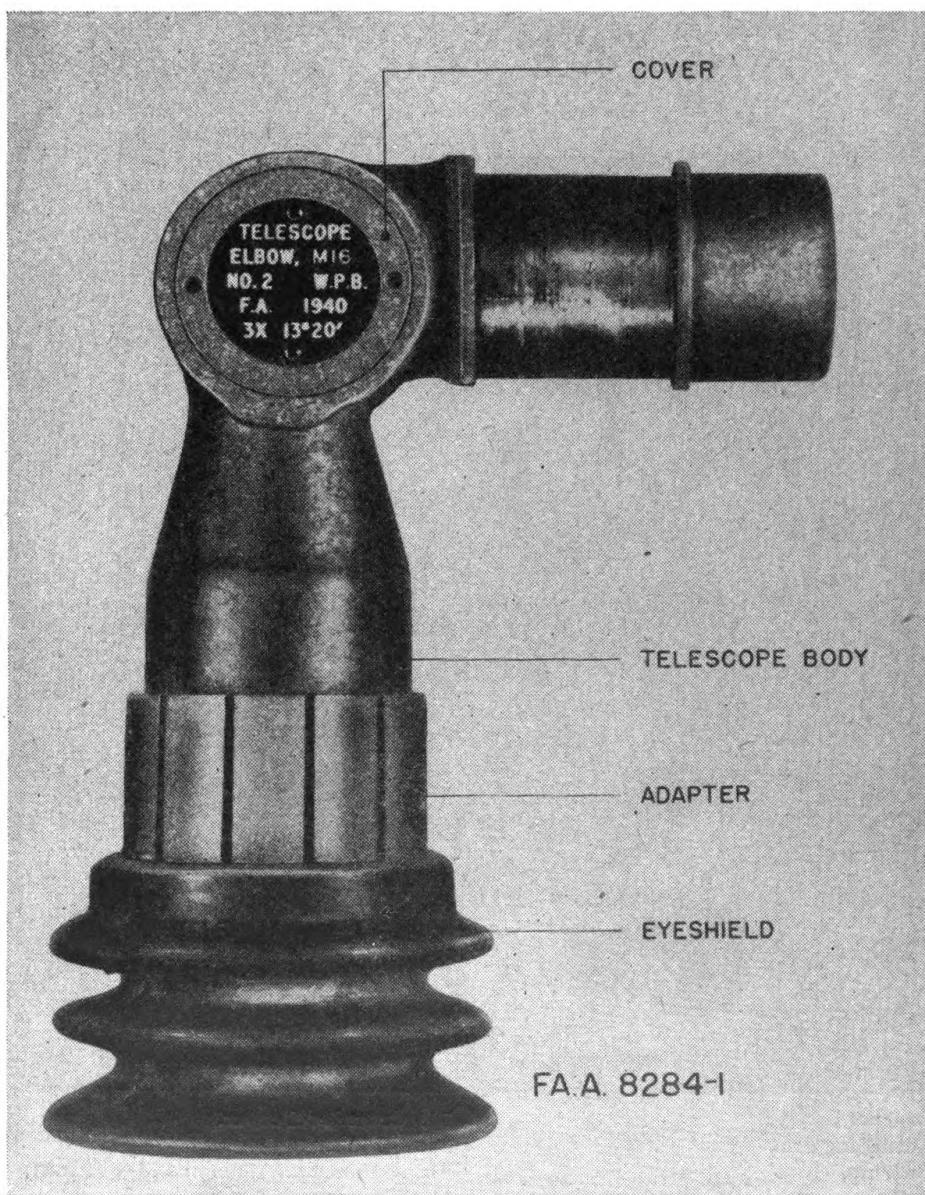


FIGURE 32.—Elbow telescope M16.

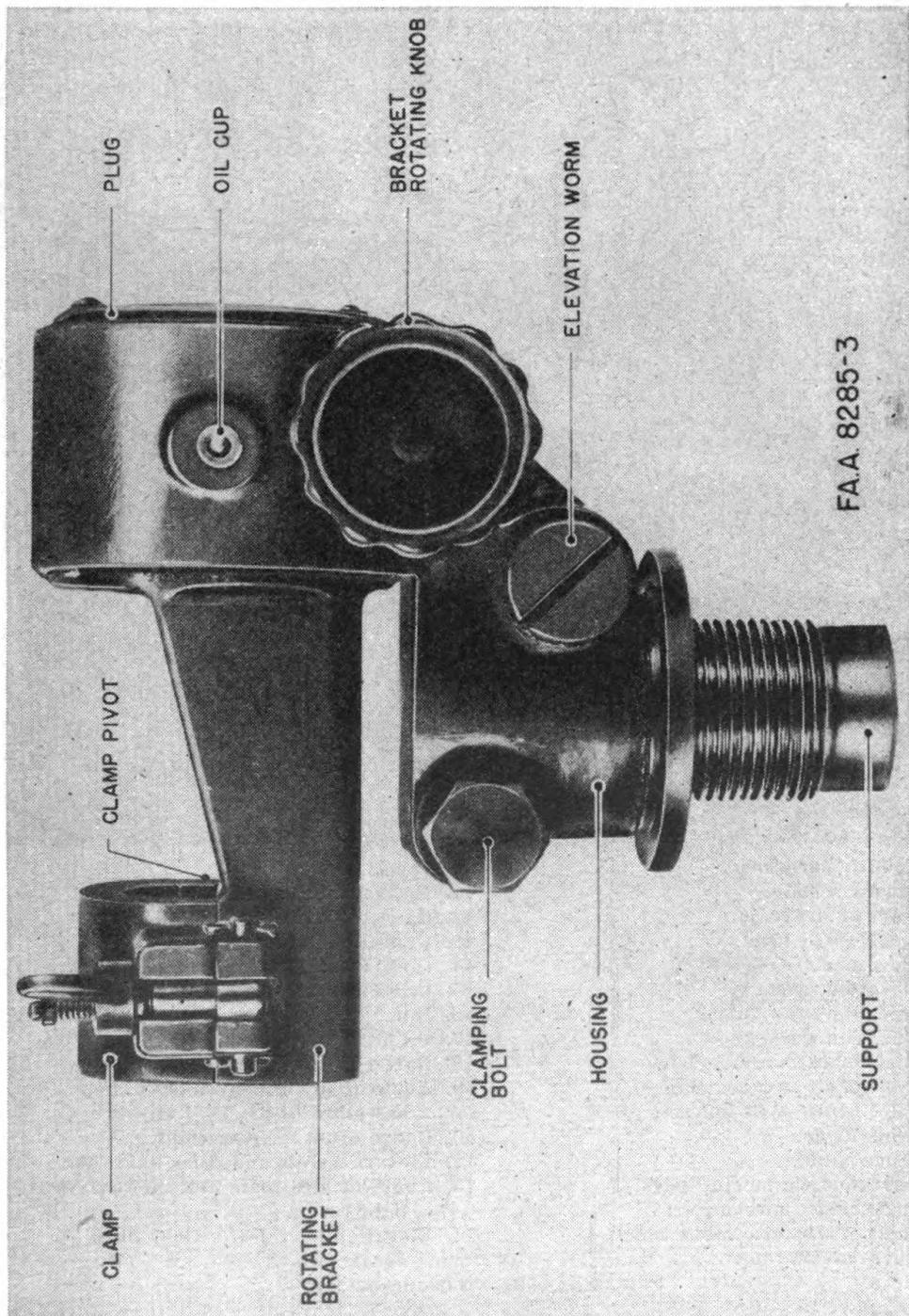
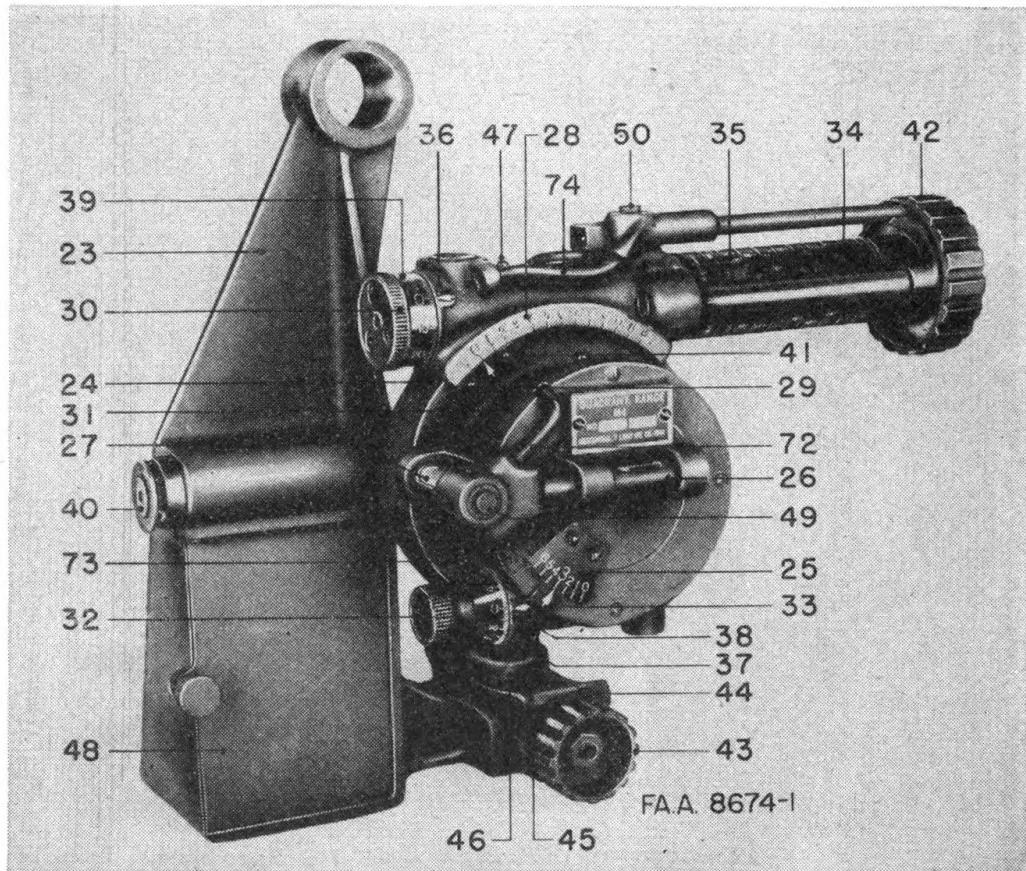


FIGURE 33.—Telescope mount M23.



23. Mounting bracket.
 24. Quadrant body.
 25. Angle of site scale.
 26. Angle of site level.
 27. Cross level.
 28. Elevation scale.
 29. Elevation scale index.
 30. Elevation worm knob.
 31. Angle of site worm housing.
 32. Angle of site worm knob.
 33. Angle of site scale index.
 34. Range drum.
 35. Range pointer.
 36. Elevation micrometer index.
 37. Angle of site micrometer.
 38. Angle of site micrometer index.
 39. Elevation micrometer.
 40. Pivot.
 41. Elevation scale index screws.
 42. Range drum knob.
 43. Cross leveling worm knob.
 44. Cross leveling worm gear segment.
 45. Cross leveling worm housing.
 46. Nut.
 47. Oil fitting.
 48. Battery box.
 49. Angle of site and cross level lamp assembly.
 50. Range drum lamp assembly.
 72. Elevation scale and index light tube.
 73. Angle of site scale and micrometer light tube.
 74. Elevation micrometer light tube.

FIGURE 34.—Range quadrant M4.

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

Mount, telescope, M21-----	}	SNL F-197
Quadrant, range, M4-----		
Telescope, elbow, M16 -----		
Mount, telescope, M23 (for elbow telescope)		
Howitzer, 105-mm, M2; carriage, 105-mm howitzer, M1; limber, light carriage, M1—parts and equipment-----		SNL C-21
Telescope, panoramic, M5A3, M5A4, etc-----		SNL F-22
Telescope, panoramic, M12, M12A1, and M12A2-----		SNL F-214
Material, cleaning and preserving, and tools and equipment used therewith-----		SNL K-1
Special oils, greases, cutting oil, welding compound, brazing material, gases, and related items-----		SNL K-2
Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index"-----		(OPSI)

2. Technical Manuals.

105-mm howitzer matériel M1A1 and M2-----	TM 9-325
Cleaning and preserving materials-----	TM 9-850
Matériel inspection and repair-----	TM 9-1100
Telescopes, panoramic, M5A3, M5A4, etc-----	TM 9-1583

[A. G. 062.11 (11-19-41).]

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(For explanation of symbols see FM 21-6.)

